SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution and affiliated to Anna University, Chennai)
Kuniamuthur, Coimbatore - 641 008

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM AND SYLLABI

B.TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION 2020 (BATCH: 21 – 25)

SRI KRISHNA COLLEGE OF ENGINEERING AND TECHNOLOGY
(An Autonomous Institution and affiliated to Anna University, Chennai)
Kuniamuthur, Coimbatore - 641 008

DEPARTMENT OF
ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION 2020 (BATCH: 21 – 25)

B.TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

ABOUT THE DEPARTMENT

VISION

To produce globally competitive professionals in Artificial Intelligence and Data Science by imparting cognitive learning and encouraging industry collaboration towards serving the greater cause of society.

MISSION

1. Impart knowledge in cutting edge Artificial Intelligence and Data Science technologies in par with industrial standards.
2. Inculcate research and lifelong learning that benefit society at large.
3. Promote ethical values and entrepreneurial skills.

PROGRAMME OUTCOMES (POs)

Artificial Intelligence and Data Science Graduates will be able to:

PO1 - **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an

understanding of the limitations.

PO6 - **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11- Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 - **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1:

To build a successful career in IT/relevant industry or carryout research in advance areas of Artificial Intelligence, Data Science and address various issues in the society.

PEO 2:

To develop problem solving skills and ability to provide solution for real time problems.

PEO 3:

To develop the ability and attitude of adapting themselves to emerging technological Challenges.

PEO 4:

To excel with excellent communication skills, leadership qualities and social responsibilities.

PROGRAMME SPECIFIC OBJECTIVES (PSO)

PSO 1:

Understand, analyze and develop innovative solutions for real world problems in industry and research establishments related to Artificial Intelligence and Data Science.

PSO 2:

Ability to choose or develop the right tool for Data analysis and develop high end intelligent systems.

PSO 3:

Apply programming principles and practices for developing software solutions to meet future business and society needs.

Mapping of PO's to PEO's

Programme Educational Objectives (PEO)	Program Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
PEO1	3	3	3	3	3	3	3	2	1	2	2	3
PEO2	3	3	3	3	3	2	2	2	2	3	3	3
PEO3	1	3	1	2	3	2	3	1	1	2	2	2
PEO4	1	1	3	2	1	3	3	3	3	3	3	1

Mapping of PO's to PSO's

Programme Specific Outcomes (PSO)	Programme Outcomes (PO)											
	1	2	3	4	5	6	7	8	9	10	11	12
PSO1	3	3	3	3	1	2	1	1	1	2	2	2
PSO2	3	3	3	1	3	1	1	1	2	2	2	3
PSO3	3	3	3	1	1	3	3	2	3	2	2	3

Mapping of PSO's & PEO's

Programme Specific Outcomes (PSO)	Programme Educational Objectives (PEO)			
	PEO1	PEO2	PEO3	PEO4
PSO1	3	3	2	2
PSO2	3	3	2	1
PSO3	3	2	3	3

1	Reasonably agreed	2	Moderately agreed	3	Strongly agreed

B. TECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION 2020 (Batch : 2021 – 2025)

SEMESTER I							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	21AD101	Python for Data Science	3/0/0	3	3	60/40	PC
THEORY CUM PRACTICAL							
2.	21MA101	Engineering Mathematics I	2/1/2	5	4	50/50	BSC
3.	21CH101	Engineering Chemistry	3/0/3	6	4.5	50/50	BSC
4.	21AD102	Computer Organization and Digital Logic	3/0/2	5	4	50/50	ESC
PRACTICAL							
5.	21AD103	Python Laboratory	0/0/3	3	1.5	40/60	PC
6	21ME103	Engineering Practices laboratory	0/0/3	3	1.5	40/60	ESC
MANDATORY COURSE							
7.	21MC101	Mandatory Course-I (Induction Programme)	3 weeks				MC
Total				**25**	**18.5**	**700**	

SEMESTER II							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1	21GE201	Universal Human Values	3/0/0	3	3	60/40	HSMC
THEORY CUM PRACTICAL							
2.	21MA201	Engineering Mathematics II	2/1/2	5	4	50/50	BSC
3.	21EN101	Technical Communication Skills	2/0/2	4	3	50/50	HSMC
4.	21PH104	Physics	3/0/3	6	4.5	50/50	BSC
5.	21AD201	Data Structures using C	3/0/2	5	4	50/50	PC

PRACTICAL							
6.	21ME111	Engineering Graphics	1/0/3	4	2.5	40/60	ESC
MANDATORY COURSE							
7.	21MC102	Mandatory Course-II (Environmental Sciences)	2/0/0	2	0	0/100	MC
Total				**29**	**21**	**700**	

SEMESTER III							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	21AD301	Artificial Intelligence Principles and Techniques	3/0/0	3	3	60/40	PC
2.	21MA302	Mathematical Structures	3/1/0	4	4	60/40	BSC
THEORY CUM PRACTICAL							
3.	21AD302	Analysis of Algorithms	3/0/2	5	4	50/50	PC
4.	21IT301	Web Development using React	3/0/2	5	4	50/50	PC
5.	21CS302	Java Programming	3/0/2	5	4	50/50	PC
6.	21CS303	Managing Data using RDBMS	3/0/2	5	4	50/50	PC
MANDATORY COURSE							
7.	21MCXXX	Mandatory Course-III	2/0/0	2	0	0/100	MC
Total				**29**	**23**	**700**	

SEMESTER IV							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	21AD401	Fundamentals of Operating Systems	3/0/0	3	3	60/40	PC
2.	21AD402	Data Warehousing and Mining	3/0/0	3	3	60/40	PC
3.	21MA404	Random Variables and Statistics	3/1/0	4	4	60/40	BSC

4.	21AD403	Cloud Computing	3/0/0	3	3	60/40	PC
5.	21IT402	Software Testing using Selenium	3/0/0	3	3	60/40	PC
6.	21CS402	Web Frameworks	3/0/0	3	3	60/40	PC
PRACTICAL							
7.	21AD404	Cloud Computing Laboratory	0/0/3	3	1.5	40/60	PC
8.	21CS403	Web Frameworks Laboratory	0/0/3	3	1.5	40/60	PC
MANDATORY COURSE							
9.	21MCXXX	Mandatory Course-IV	2/0/0	2	0	0/100	MC
Total				**27**	**22**	**900**	

SEMESTER V							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	21AD501	Fundamentals of Signals and Systems	3/0/0	3	3	60/40	ESC
2.	21AD502	Machine Learning	3/0/0	3	3	60/40	PC
3.	21AD9XX	Professional Elective –I	3/0/0	3	3	60/40	PEC
4.	21XXXXX	Open Elective –I	3/0/0	3	3	60/40	OEC
THEORY CUM PRACTICAL							
5.	21AD503	Data Science Using R	3/0/3	6	4.5	50/50	PC
PRACTICAL							
6.	21AD504	Machine Learning Laboratory	0/0/3	3	1.5	40/60	PC
7.	21AD9XX	Professional Elective –II	0/0/6	6	3	40/60	PEC
MANDATORY COURSE							
8.	21MCXXX	Mandatory Course-V	2/0/0	2	0	0/100	MC
PROJECT WORK							
9.	21AD505	Mini Project –I	0/0/2	2	1	40/60	PW
Total				**31**	**22**	**900**	

SEMESTER VI							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	21AD601	Data visualization using Tableau	3/0/0	3	3	60/40	PC
2.	21AD9XX	Professional Elective –III	3/0/0	3	3	60/40	PEC
3.	21ADXXX	Emerging Elective –I	3/0/0	3	3	60/40	EEC
THEORY CUM PRACTICAL							
4.	21AD602	AI in Natural Language Processing	3/0/3	6	4.5	50/50	PC
5.	21AD603	Introduction to Computer Networks	3/0/3	6	4.5	50/50	ESC
PRACTICAL							
6.	21AD604	Data Visualization Laboratory	0/0/3	3	1.5	40/60	ESC
7.	21AD9XX	Professional Elective –IV	0/0/6	6	3	40/60	PEC
PROJECT WORK							
8.	21AD605	Mini Project –II	0/0/2	2	1	40/60	PW
Total				**32**	**23.5**	**800**	

SEMESTER VII							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
THEORY							
1.	21AD701	Data Analytics	3/0/0	3	3	60/40	PC
2.	21AD702	Deep Learning and its Applications	3/0/0	3	3	60/40	PC
3.	21AD9XX	Professional Elective –V	3/0/0	3	3	60/40	PEC
4.	21AD9XX	Professional Elective –VI	3/0/0	3	3	60/40	PEC
5.	21XXXXX	Open Elective –II	3/0/0	3	3	60/40	OEC
6.	21ADXXX	Emerging Elective –II	3/0/0	3	3	60/40	EEC

PRACTICAL							
7.	21AD703	Data Analytics Laboratory	0/0/3	3	1.5	40/60	PC
8.	21AD704	Deep Learning Laboratory	0/0/3	3	1.5	40/60	PC
EMPLOYABILITY ENHANCEMENT SKILLS							
9.	21EES01	Employability Enhancement Skills (Summer Internship / Summer Training – 4 weeks)			2	0/100	EES
Total				**24**	**23**	**900**	

SEMESTER VIII							
S.No	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
Project Work							
1	21AD801	Project	0/0/24	24	12	40/60	PW
Total				**24**	**12**	**100**	

HUMANITIES (6 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1	21EN101	Technical Communication Skills	2/0/2	4	3	HSMC
2	21GE201	Universal Human Values	3/0/0	3	3	HSMC

BASIC SCIENCES (25 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1	21MA101	Engineering Mathematics I	2/1/2	5	4	BSC
2	21CH101	Engineering Chemistry	3/0/3	6	4.5	BSC
3	21MA201	Engineering Mathematics II	2/1/2	5	4	BSC
4	21PH104	Physics	3/0/3	6	4.5	BSC
5	21MA302	Mathematical Structures	3/1/0	4	4	BSC

6	21MA404	Random Variables and Statistics	3/1/0	4	4	BSC

ENGINEERING SCIENCE (15.5 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1.	21AD102	Computer Organization and Digital Logic	3/0/2	5	4	ESC
2.	21ME103	Engineering Practices laboratory	0/0/3	3	1.5	ESC
3.	21ME111	Engineering Graphics	1/0/3	4	2.5	ESC
4.	21AD501	Fundamentals of Signals and Systems	3/0/0	3	3	ESC
5.	21AD603	Introduction to Computer Networks	3/0/3	6	4.5	ESC

PROFESSIONAL CORE (72.5 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1.	21AD101	Python for Data Science	3/0/0	3	3	PC
2.	21AD103	Python Laboratory	0/0/3	3	1.5	PC
3.	21AD201	Data Structures using C	3/0/2	5	4	PC
4.	21AD301	Artificial Intelligence Principles and Techniques	3/0/0	3	3	PC
5.	21AD302	Analysis of Algorithms	3/0/2	5	4	PC
6.	21IT301	Web Development using React	3/0/2	5	4	PC
7.	21CS303	Managing Data using RDBMS	3/0/2	5	4	PC
8.	21CS302	Java Programming	3/0/2	5	4	PC
9.	21AD401	Fundamentals of Operating Systems	3/0/0	3	3	PC
10.	21AD402	Data Warehousing and Mining	3/0/0	3	3	PC

11.	21IT402	Software Testing using Selenium	3/0/0	3	3	PC
12.	21AD403	Cloud Computing	3/0/0	3	3	PC
13.	21CS402	Web Frameworks	3/0/0	3	3	PC
14.	21AD404	Cloud Computing Laboratory	0/0/3	3	1.5	PC
15.	21CS40	Web Frameworks Laboratory	0/0/3	3	1.5	PC
16.	21AD502	Machine Learning	3/0/0	3	3	PC
17.	21AD503	Data Science Using R	3/0/3	6	4.5	PC
18.	21AD504	Machine Learning Laboratory	0/0/3	3	1.5	PC
19.	21AD602	AI in Natural Language Processing	3/0/3	6	4.5	PC
20.	21AD601	Data visualization using Tableau	3/0/0	3	3	PC
21.	21AD604	Data Visualization Laboratory	0/0/3	3	1.5	PC
22.	21AD701	Data Analytics	3/0/0	3	3	PC
23.	21AD702	Deep Learning and its Applications	3/0/0	3	3	PC
24.	21AD703	Data Analytics Laboratory	0/0/3	3	1.5	PC
25.	21AD704	Deep Learning Laboratory	0/0/3	3	1.5	PC

PROFESSIONAL ELECTIVES (18 CREDITS)

PROFESSIONAL ELECTIVE STREAM I (SOFTWARE DEVELOPMENT)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credits	Category
1.	21AD901	Artificial Neural Networks	3/0/0	3	3	PEC
2.	21AD902	Semantic Web	3/0/0	3	3	PEC

3.	21AD903	Virtual Reality and Augmented Reality	3/0/0	3	3	PEC
4.	21AD904	Bio Informatics	3/0/0	3	3	PEC
5.	21AD905	Internet of Things	3/0/0	3	3	PEC
6.	21AD906	APP Development	0/0/6	6	3	PEC
7.	21CS901	API Development using MVC Architecture	3/0/0	3	3	PEC
8.	21IT901	UI / UX Application Development	3/0/0	3	3	PEC
9.	21CS902	Cloud services and Integration	3/0/0	3	3	PEC
10.	21IT902	Advanced Application Development	0/0/6	6	3	PEC

PROFESSIONAL ELECTIVE STREAM II (DATA SCIENCE AND COMPUTATIONAL INTELLIGENCE)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credits	Category
1.	21AD911	Statistics and Machine Learning	3/0/0	3	3	PEC
2.	21IT911	NLP with Predictive Analysis	3/0/0	3	3	PEC
3.	21AD912	Bayesian Data Analysis	3/0/0	3	3	PEC
4.	21AD913	Information Extraction and Retrieval	3/0/0	3	3	PEC
5.	21AD914	Biology for Engineers	2/0/2	3	3	PEC
6.	21AD915	Web and Social media Mining	3/0/0	3	3	PEC
7.	21AD916	Introduction to Brain and Neuroscience	3/0/0	3	3	PEC

PROFESSIONAL ELECTIVE STREAM III (NETWORKS AND SECURITY)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credits	Category
1.	21AD921	Ethical Hacking	3/0/0	3	3	PEC

2.	21AD922	Ethical Hacking and Auditing Frameworks	3/0/0	3	3	PEC
3.	21IT921	Cyber Security	3/0/0	3	3	PEC
4.	21CS921	Cyber Threats and Vulnerabilities	3/0/0	3	3	PEC
5.	21AD923	Image Signal processing	3/0/0	3	3	PEC
6.	21AD924	Computational Statistics for Data Science	3/0/0	3	3	PEC
7.	21AD925	Ethics in Data Science	3/0/0	3	3	PEC
8.	21AD926	Business Intelligence	3/0/0	3	3	PEC
9.	21AD927	Intelligent Multi Agent and Expert systems	3/0/0	3	3	PEC

OPEN ELECTIVE COURSES (6 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1.	21AD001	Fundamentals of Database Systems	3/0/0	3	3	OEC
2.	21AD002	Information Retrieval Techniques	3/0/0	3	3	OEC
3.	21AD003	Machine Learning Algorithms in Python	3/0/0	3	3	OEC
4.	21AD004	Data Visualization using R	3/0/0	3	3	OEC
5.	21AD005	Introduction to Data Analytics	3/0/0	3	3	OEC
6.	21AD006	Introduction to Deep Learning	3/0/0	3	3	OEC

EMERGING ELECTIVE COURSES (6 CREDITS)

S.No	Course Code	Course	L/T/P	Contact hrs/week	Credit	Category
1.	21AD007	Autonomous Systems and Drones	3/0/0	3	3	EEC
2.	21AD008	Crypto currencies	3/0/0	3	3	EEC

3.	21AD009	AI in Healthcare Applications	3/0/0	3	3	EEC
4.	21AD010	Scalable System for Data Science	3/0/0	3	3	EEC
5.	21AD011	Computer Vision	3/0/0	3	3	EEC
6.	21AD012	Data Engineering on Google Cloud Platform	3/0/0	3	3	EEC
7.	21AD013	Predictive Analytics	3/0/0	3	3	EEC

EMPLOYABILITY ENHANCEMENT SKILLS (2 CREDITS)

S.No	Course Code	Course	Duration	Credit	Category
1.	21EES01	Employability Enhancement Skills (Summer Internship / Summer Training)	4 WEEKS	2	EES

MANDATORY COURSES (NON-CREDIT)

S.No	Course Code	Course	Category
1.	21MC101	Induction Programme	MC
2.	21MC102	Environmental Sciences	MC
3.	21MC103	Soft Skills	MC
4.	21MC104	Management Organizational Behaviour	MC
5.	21MC105	General Aptitude	MC
6.	21MC106	Life Skills and Ethics	MC
7.	21MC107	Stress Management	MC
8.	21MC108	Constitution of India	MC
9.	21MC109	Essence of Indian Traditional Knowledge	MC
10.	21MC110	Biology	MC

Scheme of Distribution

S.NO	Stream	Credits/Semester								Credits	AICTE Norms
		I	II	III	IV	V	VI	VII	VIII		
1.	Humanities (HSMC)		6							6	12
2.	Basic Sciences (BSC)	8.5	8.5	4	4					25	24
3.	Engineering Sciences (ESC)	5.5	2.5			3	4.5			15.5	29
4.	Professional Core (PC)	4.5	4	19	19.5	8.5	9	8		72.5	49
5.	Professional Electives (PEC)					6	6	6		18	18
6.	Open Elective (OEC)					3		3		6	12
7.	Emerging Electives (EEC)						3	3		6	
8.	Project work (PW)					1	1		12	14	15
9.	Employability Skills							2		2	
10.	Mandatory Course (MC)									-	
Total		**18.5**	**21**	**23**	**22**	**22**	**23.5**	**23**	**12**	**165**	
AICTE(CSE)		17.5	20.5	23	22	21	22	20	15		159

21AD101	PYTHON FOR DATA SCIENCE	3/0/0/3
Nature of Course	F (Theory and Programming)	

Course Objectives:

1	To understand and execute Python script using types and expressions
2	To understand the difference between expressions & statements and to understand the concept of assignment semantics.
3	To utilize high level data types such as lists and dictionaries.
4	To import and utilize a module and to perform read & write operations on files.
5	To use latest python libraries for data science in real time paradigms.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recognize the general principles and good Algorithmic problem solving.	[U]
C101.2	Read, write, execute by hand simple Python programs.	[U]
C101.3	Structure simple Python programs for solving problems.	[U]
C101.4	Decompose a Python program into functions.	[AP]
C101.5	Represent compound data using Python lists, tuples and dictionaries.	[AP]
C101.6	Read and write data from data sheets and Analyse data.	[A]

Course Contents:

Algorithmic Problem Solving, Data, Expressions and Statements: (15 Hrs)

Algorithms, Building Blocks of Algorithms (Statements, State, Control Flow, Functions), Notation(Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple Strategies For Developing Algorithms (Iteration, Recursion). Illustrative Problems: Find Minimum In A List, Insert A Card In A List Of Sorted Cards, Guess An Integer Number In A Range, Towers of Hanoi. **-** Python Interpreter And Interactive Mode; Values And Types: Int, Float, Boolean, String, And List; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules And Functions, Function Definition And Use, Flow of Execution, Parameters And Arguments; Illustrative Programs: Exchange The Values of Two Variables, Circulate The Values of N Variables, Distance Between Two Points.

Control Flow, Functions, Lists, Dictionaries: (15 Hrs)

Conditionals: Boolean Values And Operators, Conditional (If), Alternative (If-Else), Chained Conditional (If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful Functions: Return Values, Parameters, Local And Global Scope, Function Composition, Recursion; Strings:

String Slices, Immutability, String Functions And Methods, String Module; Lists As Arrays. Illustrative Programs: Square Root, GCD. Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple As Return Value; Dictionaries: Operations And Methods, Exception handling, Files-reading and writing

Python Libraries for Data Science: (15 Hrs)

Basics for Data Science: Loading the Data from CSV file, Cleaning the Data, Visualization, Numpy and Numpy Operations, Pandas and pandas operations, Matplotlib: types of plots.

Case study: Analyze the academic performance of students and plot a graph.

Total Hours:	**45**

Text Books:

1	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/)
2	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3	Fabio Nelli, "Python Data Analytics: Data Analysis and science using pandas, matplotlib and python programming language", Apress.

Reference Books:

1	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.
2	Timothy A. Budd, "Exploring Python", Mc Graw Hill Education (India) Private Ltd., 2015.
3	John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013.
4	Peter Morgan, "Data Analysis from scratch with python: Beginner guide using python, pandas, Numpy, SCIKIT-learn, IPython, TensorFlow and Matplotlib", AI Sciences, 2018.

Web References:

1	http://nptel.ac.in/courses/106106145/
2	https://www.codecademy.com/learn/learn-python
3	https://www.coursera.org/learn/python-data-analysis#syllabus

Online Resources:

1	https://www.programiz.com/python-programming
2	https://www.fullstackpython.com/best-python-resources
3	https://www.youtube.com/watch?v=edvg4eHi_Mw

Assessment Methods & Levels (based on Blooms'Taxonomy)			
Formative assessment based on Capstone Model (16%)			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)**	**Marks**
C101.1, C101.2	Understand	Quiz	4
C101.3	Understand	Assignment	4
C101.4	Apply	Idea Presentation	4
C101.5	Analyze	Case Study	4

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (24%)**		**End Semester Examination (60%) [60 Marks]**
	CIA1 [12 Marks]	**CIA2 [12 Marks]**	
Remember	10	10	10
Understand	30	30	30
Apply	30	30	30
Analyse	30	30	30
Evaluate			
Create			

Summative assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%)						**End Semester Examination (60 %)**
CA 1 (20 Marks)			**CA 2 (20 Marks)**			**Theory Examination (60 Marks)**
SA 1 (12 Marks)	**FA 1**		**SA 2 (12 marks)**	**FA 2**		
	Component -I (4 marks)	**Component –II (4 marks)**		**Component -I (4 marks)**	**Component -II (4 marks)**	

* SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
* FA1 & FA 2 is internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
* ES exams conducted and evaluated for 100 marks.

Mapping of Course Outcomes (CO) with Programme Outcomes(PO) and Programme Specific Outcomes(PSO)															
COs	**POs**												**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
C101.1	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3

C101.2	3	3	3	3	2	2	2	3			2	3	3	3	2
C101.3	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C101.4	3	3	3	3	2	2	2	3			2	3	2	2	3
C101.5	3	3	2	2	3	3	3	3			2	2	3	3	
C101.6	3	3	2	2	3	3	3	3			2	2	3	3	3

21MA101	ENGINEERING MATHEMATICS I	2/1/2/4
Nature of Course	J (Problem analytical)	
Pre requisites	Concept of Differentiation and Matrices	

Course Objectives:

1	To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2	To know about system of linear equations and its solution set and how to write down the coefficient matrix and augmented matrix of a linear system
3	To familiarize with functions of several variables applicable in many branches of engineering.
4	To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives.	[R]
C101.2	Express square matrix in the diagonal form.	[U]
C101.3	Solve systems of linear equations numerically and to find inverse matrices.	[AP]
C101.4	Apply numerical techniques effectively to analyse and visualize data to solve basic engineering-related problems.	[AP]
C101.5	Find the extreme values of the given functions to solve the engineering problems.	[AP]
C101.6	Find the solution of second and higher order differential equations connected with electric circuits and simple harmonic motion.	[AP]

Course Contents:

MATRICES: (14 Hrs)

Definition – Types of matrices – Characteristic equation – Eigenvalues and eigenvectors of a real matrices and their properties (statement only) – Cayley-Hamilton theorem (statement only) – Verification and application to find inverse and powers of real matrices – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by Orthogonal transformation.

SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS: (16 Hrs)

Newton-Raphson method – Fixed point iteration method– Gauss-Elimination method – Gauss-Jordan method –Iterative methods of Gauss-Jacobi and Gauss-Seidel – Matrix Inversion by Gauss-Jordan method – Eigenvalue of a matrix by Power method and Jacobi method.

CALCULUS: **(18 Hrs)**

Concepts of limits and continuity –Functions of several variables – Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers – Ordinary differential equations –Higher order linear differential equations with constant coefficients –Euler Cauchy's equations – Applications of ODE: Solving electrical circuits and simple harmonic motion.

Lab Component

1. Entering row vector, column vector, accessing blocks of elements in MATLAB.
2. Entering matrices, to locate matrix elements and correcting any entry through indexing in MATLAB.
3. Sum, product, transpose, inverse, determinant and rank of a matrices using MATLAB.
4. Eigenvalues and eigenvectors of a matrix using MATLAB.
5. System of linear equations in MATLAB using Gaussian elimination.
6. System of linear equations in MATLAB using matrix inverse method.
7. System of linear equations in MATLAB using linsolve.
8. First and second derivative of single variable functions using MATLAB.
9. Maxima and Minima of a function using MATLAB.
10. Higher Order Equations of constant coefficients using MATLAB.

Total Hours:(48+12)	**60**

Text Books:

1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14thEdition,Pearson, Reprint,2018
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2018.

Reference Books:

1	Veerarajan. T, "Engineering Mathematics I", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.

Web References:

1	http://www.nptel.ac.in/courses/111105035
2	http://www.nptel.ac.in/courses/122104017
3	http://nptel.ac.in/courses/122102009
4	http://nptel.ac.in/courses/111107063
Online Resources:	
1	https://www.coursera.org/learn/linearalgebra2
2	https://www.coursera.org/learn/differentiation-calculus
3	https://www.coursera.org/learn/single-variable-calculus
4	https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

<table>
<tr><th colspan="8">Summative assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="7">Continuous Assessment (50%)</th><th>End Semester Examination (50%)</th></tr>
<tr><th colspan="2">CA 1
(10 Marks)</th><th colspan="3">CA 2
(10 Marks)</th><th colspan="2">Practical Exam
(30 Marks)</th><th>Theory Examination (50 Marks)</th></tr>
<tr><th rowspan="2">SA 1
(6 marks)</th><th colspan="2">FA 1</th><th rowspan="2">SA 2
(6 marks)</th><th colspan="2">FA 2</th><th>FA
(22 marks)</th><th>SA
(8 marks)</th><th rowspan="2"></th></tr>
<tr><th>Component -I
(2 marks)</th><th>Component -II
(2 marks)</th><th>Component -III
(2 marks)</th><th>Component -IV
(2 marks)</th></tr>
<tr><th colspan="8">Assessment Methods & Levels (based on Blooms'Taxonomy) - Theory</th></tr>
<tr><th colspan="8">Formative assessment based on Capstone Model (8%)</th></tr>
<tr><th>Course Outcome</th><th>Bloom's Level</th><th colspan="2">Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)</th><th colspan="4">Marks</th></tr>
<tr><td>C101.1</td><td>Remember</td><td colspan="2">Component – I</td><td colspan="2">Quiz</td><td colspan="4">2</td></tr>
<tr><td>C101.2</td><td>Understand</td><td colspan="2">Component - II</td><td colspan="2">Assignment</td><td colspan="4">2</td></tr>
<tr><td>C101.3</td><td>Apply</td><td colspan="2" rowspan="2">Component - III</td><td colspan="2" rowspan="2">Seminar</td><td colspan="4" rowspan="2">2</td></tr>
<tr><td>C101.4</td><td>Apply</td></tr>
<tr><td>C101.5</td><td>Apply</td><td colspan="2">Component - IV</td><td colspan="2">Tutorial</td><td colspan="4">2</td></tr>
<tr><th colspan="8">Summative assessment based on Continuous and End Semester Examination</th></tr>
<tr><th rowspan="2">Bloom's Level</th><th colspan="3">Continuous Assessment (12%)</th><th colspan="4" rowspan="2">End Semester Examination (50%)
[50 Marks]</th></tr>
<tr><th colspan="2">CIA1
[6 Marks]</th><th colspan="2">CIA2
[6 Marks]</th></tr>
<tr><td>Remember</td><td colspan="2">30</td><td colspan="2">30</td><td colspan="4">20</td></tr>
<tr><td>Understand</td><td colspan="2">50</td><td colspan="2">40</td><td colspan="4">50</td></tr>
<tr><td>Apply</td><td colspan="2">20</td><td colspan="2">30</td><td colspan="4">30</td></tr>
<tr><td>Analyse</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="4">-</td></tr>
<tr><td>Evaluate</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="4">-</td></tr>
<tr><td>Create</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="4">-</td></tr>
<tr><th colspan="8">Summative assessment based on Continuous and End Semester Examination – Practical</th></tr>
<tr><th rowspan="2">Bloom's Level</th><th colspan="7">Continuous Assessment (30%)</th></tr>
<tr><th colspan="3">FA
(22 Marks)</th><th colspan="4">SA
(8 Marks)</th></tr>
</table>

Remember	20	20
Understand	30	30
Apply	50	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes(PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1	3	2	3						2				2		
C101.2	2	2	2						1				2		
C101.3	1	2	2										2	2	
C101.4	2	2	2						2				2	1	
C101.5	2	3	2						2				2	1	
C101.6	2	3	2						2				2	1	

21CH101	ENGINEERING CHEMISTRY	3 /0 /3 /4.5
Nature of Course	: E (Theory skill based)	
Pre requisites	: NIL	

Course Objectives:

1	To make the students conversant with water treatment, boiler feed water techniques.
2	To learn the effect of corrosion in materials and the methods for prevention of corrosion.
3	To understand the principles and applications of electrochemistry and to learn electro analytical methods.
	To understand the basic concepts, synthesis, and applications of nanomaterials.
4	To explore the synthesis and properties of important engineering plastics, energy
5	sources and drug molecules.
	To understand the concepts of photophysical and photochemical processes in
6	spectroscopy.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the requirements of water treatment procedures and boiler feed water for industries.	[R]
C101.2	Apply the various corrosion control techniques in real time industrial environments.	[AP]
C101.3	Understand the principle and working of reference electrodes and conductivity meters as an analyzer.	[U]
C101.4	Understand the basic concepts and applications of Nanochemistry.	[U]
C101.5	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[AP]
C101.6	Understand the principle and working of certain analytical techniques, and synthesis of some common drug molecules.	[U]

Course Contents:

Water chemistry and Corrosion: **15 Hours**

Water treatment-characteristics of water-hardness-types and estimation of hardness by EDTA method with numerical problems. Boiler feed water–requirements-disadvantages of hard water. Domestic water treatment-disinfection methods (chlorination, Ozonation, UV treatment)-demineralization process–desalination-reverse osmosis. Corrosion-types–mechanism of dry and wet corrosion-galvanic corrosion-differential aeration corrosion-protective coatings-electroplating of gold-electroless plating of nickel.

Electrochemistry and Energy sources: **15 Hours**

Electrochemical cells-electrolytic cell-reversible and irreversible cells – Free energy and emf, cell potentials, Nernst equation and applications. Oxidation and reduction potentials-standard hydrogen electrode, saturated calomel electrode, glass electrode-pH measurement. Nanochemistry-Basics-Comparison of molecules, nanomaterials and bulk materials; Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: Electrochemical deposition and electro spinning. Applications of nanomaterials in medicine. Energy Sources-Fuel cells (H_2-O_2). Storage Devices-Batteries- Alkaline-Lead acid, Nickel cadmium and Lithium-ion batteries.

Polymer chemistry, Spectroscopic techniques and Synthesis of drug molecules: 15 Hours

Introduction-monomers and polymers-classification of polymers-Polymerization-types. Mechanism of addition polymerization (free radical mechanism). Plastics-classification-preparation, properties and uses of Nylon 6,6, Nylon 6, PVC, Bakelite and PET. Moulding methods- moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays (Compression moulding) and PET bottles (Blow moulding). Spectroscopy-Beer Lambert's law, principle, instrumentation, and applications of Electronic spectroscopy (UV-visible), Vibrational and rotational spectroscopy (IR) and Flame emission spectroscopy (FES). Synthesis of a commonly used drug molecule-Asprin, p-nitroaniline from acetanilide.

Field work:

Industrial visit- Water treatment plant / Sewage treatment plant / Reverse osmosis plant

Lab Components:

1	Estimation of hardness of water by EDTA method	[E]
2	Estimation of alkalinity of water sample	[E]
3	Determination of chloride content in bleaching powder	[E]
4	Estimation of dissolved oxygen in water	[E]
5	Potentiometry- determination of redox potentials and emf's	[E]
6	Conductometric titration-mixture of acids vs NaOH	[E]
7	Determination of strength of strong acid by pH metry	[E]
8	Corrosion rate of mild steel in acid medium	[E]
9	Electroplating of nickel over copper	[E]
10	Spectrophotometry-Estimation of iron in water	[E]
11	Separation of mixture of amino acids by thin layer chromatography	[E]
12	Synthesis of Nylon 66	[E]
	Total Hours:	**75**

Understanding the concepts by simple Demonstrations/Experiments:	
1	To observe the hardness of given water sample by soap solution test
2	To view the colour of the different medium of given water sample using litmus paper test
3	To detect the chlorine content in tap water using simple chemical method
4	To know the presence of dissolved oxygen in given water sample using glucose by redox principle
5	To illustrate the rate of corrosion in steel nails using acid medium
Text Books:	
1	Dara S.S, Umare S.S, "Engineering Chemistry", First revised Edition by S. Chand & Company Ltd., New Delhi 2015.
2	Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
3	Fundamentals of Molecular Spectroscopy, 4th Edition by C. N. Banwell Publishing McGraw-Hill Book Company (P) Ltd, England, 1994.
4	Physical Chemistry, 11th Edition by P. W. Atkins Publishing Oxford University Press (P) Ltd, United Kingdom, 2018.
5	Nanochemistry, 2nd Edition by K. Klabunde, G. Sergeev Springer Publisher, 2013.
6	N.Krishna Murthy, Vallinayagam D.,"Engineering Chemistry" 3rd Edition by PHI Learning Pvt Ltd.,2014
7	Sunita Rattan, A Text Book of Engineering Chemistry, Student Edition by SK Kataria Publishers, 2013.
8	R.V.Gadag, A.Nithyananda Shetty "Engineering Chemistry" 3rd Edition PHI Learning Pvt Ltd., 2014.
Reference Books:	
1	Shikha Agarwal., "Engineering Chemistry and Applications", Cambridge University press, 2016.
2	Liliya.,Bazylak.I.,Gennady.E.,Zaikov.,Haghvi.A.K.,"Polymers and Polymeric Composites" CRC Press,2014.
3	Lefrou.,Christine.,Fabry.,Pierre.,Poignet.,Jean-claude.,"Electrochemistry – The Basics, with examples" 2012 ., Springer.
4	Zaki Ahmad, Digby Macdonald, "Principles of Corrosion Engineering and Corrosion Control", Elsevier Science, 2nd Edition 2012.
5	Perez, Nestor,"Electrochemistry and Corrosion Science", Springer, 2016.

6	Introduction to Nano: basics to Nanoscience and Nanotechnology, by Sengupta, Amretashis, Sarkar, Chandan Kumar, Springer Publisher, 2015.
7	Ghazi A.Karim. “Fuels, Energy and the Environment”, CRC Press, Taylor and Francis group, 2012.
Web References:	
1	http://www.analyticalinstruments.in/home/index.html
2	www.springer.com › Home › Chemistry › Electrochemistry
3	https://www.kth.se/…/electrochem/welcome-to-the-division-of-applied-electrochemistry
4	www.edx.org/
5	https://www.ntnu.edu/studies/courses
6	www.corrosionsource.com/
Online Resources:	
1 2 3 4 5 6	nptel.ac.in/courses/105104102/hardness.htm https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com – Spectroscopic technique, Colorimetry https://ocw.mit.edu/courses/chemistry nptel.ac.in/courses/113108051

<table>
<tr><td colspan="9">Summative assessment based on Continuous and End Semester Examination</td></tr>
<tr><td colspan="8">Continuous Assessment (50%)</td><td>End Semester Examination (50%)</td></tr>
<tr><td colspan="3">CA 1
(10 Marks)</td><td colspan="3">CA 2
(10 Marks)</td><td colspan="2">Practical Exam
(30 Marks)</td><td rowspan="3">Theory Examination (50 Marks)</td></tr>
<tr><td rowspan="2">SA 1
(6 Marks)</td><td colspan="2">FA 1</td><td rowspan="2">SA 2
(6 marks)</td><td colspan="2">FA 2</td><td rowspan="2">FA
(22 marks)</td><td rowspan="2">SA
(8 Marks)</td></tr>
<tr><td>Component -I
(2 marks)</td><td>Component -II
(2 marks)</td><td>Component -III
(2 marks)</td><td>Component -IV
(2 marks)</td></tr>
<tr><td colspan="9">Assessment Methods & Levels (based on Blooms’Taxonomy) - Theory</td></tr>
<tr><td colspan="9">Formative assessment based on Capstone Model (8%)</td></tr>
<tr><td>Course Outcome</td><td>Bloom’s Level</td><td colspan="5">Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)</td><td>Marks</td></tr>
<tr><td>C101.1</td><td>Apply</td><td colspan="3">Component – I</td><td colspan="3">Classroom or online Quiz</td><td>2</td></tr>
<tr><td>C101.2</td><td>Remember</td><td colspan="3">Component - II</td><td colspan="3">Group Assignment</td><td>2</td></tr>
<tr><td>C101.3</td><td>Understand</td><td colspan="3">Component - III</td><td colspan="3">Presentation</td><td>2</td></tr>
<tr><td>C101.4</td><td>Apply</td><td colspan="3" rowspan="2">Component – IV</td><td colspan="3" rowspan="2">Group Activities</td><td rowspan="2">2</td></tr>
<tr><td>C101.5</td><td>Understand</td></tr>
<tr><td colspan="9">Summative assessment based on Continuous and End Semester Examination</td></tr>
<tr><td>Bloom’s Level</td><td colspan="6">Continuous Assessment (12%)</td><td colspan="2"></td></tr>
</table>

	CIA1 [6 Marks]	CIA2 [6 Marks]	End Semester Examination (50%) [50 Marks]
Remember	30	30	20
Understand	50	40	50
Apply	20	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative assessment based on Continuous and End Semester Examination – Practical		
Bloom's Level	Continuous Assessment (30%)	
	FA (22 Marks)	SA (8 Marks)
Remember	20	20
Understand	30	30
Apply	50	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1	2	1	1				1						1		
C101.2	2	2	2				2						2		
C101.3	3	2	3				2						3		
C101.4	2	2	3				3		1				2		
C101.5	2	2	2				2						2		
C101.6	2	2	2				2						2		

21AD102	COMPUTER ORGANIZATION AND DIGITAL LOGIC	3/0/2/4
Nature of Course	: F (Theory Programming)	
Pre requisites	: NIL	

Course Objectives:

1	To study the concepts of the basic structure and operation of a digital computer.
2	To understand the concepts of algorithmic problem solving.
3	To learn the working of different types of arithmetic operations.
4	To understand the basics of sequential logic devices and the design of sequential circuits.
5	To learn the working of different types of memories and advanced processor architecture.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Encode information in binary and to manipulate Boolean functions using Boolean algebra.	[AP]
C102.2	Minimize Boolean functions and implement them using digital logic gates.	[A]
C102.3	Recognize the design of the various units of digital computers that store and process information via instructions.	[R]
C102.4	Review the functionality of all components and connectivity to the Central Processing Unit.	[U]
C102.5	Review and apply the importance and challenges of parallel processing.	[AP]
C102.6	Understand the different types of multiprocessors and functionalities.	[U]

Course Contents:

Number Systems and Boolean Algebra: (15 Hrs)

Introduction -Base Conversion-Binary codes- Complements. **Boolean Algebra**: Properties of boolean algebra-Boolean functions – Minimization of Boolean Functions using Karnaugh Maps Implementation of Logic Circuits using Gates – Code Conversion- **Combinational Logic** – Combinational circuits- Binary Adder - Subtractor - Decimal Adder - Binary Multiplier – Decoders - Encoders - **Sequential Logic**- Flip-flops, Triggering of Flip-flops, Analysis of clocked sequential circuits, Design Procedure.

Architecture Fundamentals and Memory Organization: (15 Hrs)

Organization of the Von Neumann Machine - Basic Operational Concepts of a Machine - Memory Locations and Addresses – Instruction Format - Instruction Sets, Addressing Modes and Assembly Language. Memory Organization**:** Basic Concepts, Semiconductor RAMs, ROMs, Cache memories, Performance Consideration, Virtual Memory and Memory Management requirements - Secondary storages.

Advanced Architecture: **(15 Hrs)**

Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors – Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message - Passing Multiprocessors.

Lab Experiments:

1. Realization of Boolean Functions Using Logic Gates
2. Analysis and Synthesis of Combinational Logic Circuits
3. Design and implement combinational circuits using MSI devices:
   - 4 –bit binary adder / subtractor
   - Parity generator / checker
   - Magnitude Comparator
   - Application using multiplexers
4. Design and implementation of a simple digital system
5. Design and Implementation of Shift Registers.
6. Design and Implement synchronous counters.
7. Memory unit design and perform memory operations.
8. Interfacing of CPU and Memory

Total Hours:	**60 Hours**

Text Books:

1	David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.
2	Carl Hamachar, ZvoncoVranesic and SafwatZaky, "Computer Organization", McGraw-Hill, 6th Edition 2018.
3	M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", 6th Edition, Pearson, 2018.

Reference Books:

1	William Stallings, Computer Organization and Architecture –Designing for Performance, Eighth Edition, Pearson Education, 2010.
2	John F. Wakerly, "Digital Design: Principles and Practices", 5th Edition, Pearson, 2018.
3	Donald P leach, Albert Paul Malvino, GoutamSaha,"Digital Principles and Application", 8th Edition., McGraw Hill education (India) Private Limited, 2015.

Web References:	
1	http://www.hp.com/hpinfo/newsroom/press_kits/2013/hpmoonshot2013/DS_Moonshot_System.pdf
2	https://www.hpe.com/h20195/v2/getpdf.aspx/c04168328.pdf?ver=11
3	http://documents.opto22.com/casestudies/2183_Case_Study_San_Diego_Supercomputer_Center.pdf
Online Resources:	
1	https://www.coursera.org/learn/making-architecture
2	https://www.coursera.org/learn/comparch
3	http://nptel.ac.in/video.php?subjectId=106102062
4	http://nptel.ac.in/courses/106102062/

Assessment Methods & Levels (based on Blooms'Taxonomy) - Theory				
Formative assessment based on Capstone Model (8%)				
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)**		**Marks**
C102.1	Apply	Component – I	Classroom or online Quiz	2
C102.2	Remember	Component - II	Group Assignment	2
C102.3	Analyze	Component - III	Presentation	2
C102.4	Apply	Component – IV	Group Activities	2
C102.5	Understand			

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (12%)**		**End Semester Examination (50%) [50 Marks]**
	CIA1 [6 Marks]	**CIA2 [6 Marks]**	
Remember	30	30	20
Understand	50	40	50
Apply	20	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative assessment based on Continuous and End Semester Examination (Practical)		
Bloom's Level	**Continuous Assessment (30%)**	
	FA (22 Marks)	**SA (8 Marks)**
Remember	20	20
Understand	30	30

Apply	50	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Summative Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CA 1 (10 Marks)			**CA 2 (10 Marks)**			**Practical Exam (30 Marks)**		**Theory Examination (50)**
SA 1 (6)	**FA 1**		**SA 2 (6)**	**FA 2**		**FA (22)**	**SA (8)**	
	Comp -I (2)	**Comp -II (2)**		**Comp - I (2)**	**Comp - II (2)**			

COs	**POs**												**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**J**	**k**	**l**	**1**	**2**	**3**
C102.1	3	3	3	3								2	3	2	1
C102.2	2	3	3	2	2							2	3	1	1
C102.3	3	3	3	2	3							2	3	3	1
C102.4	2	3	3	3	2								2	2	2
C102.5	2	2	3	1	2								3	3	2
C102.6	3	3	3	3	3							1	3	1	2

3	Strongly agreed	2	Moderately agreed	1	Weakly agreed	

21AD103	PYTHON LABORATORY	0/0/3/1.5

Nature of Course	L (Programming)

Course Objectives:

1	To understand and execute Python script using types and expressions.
2	To understand the difference between expressions & statements and to understand
3	the concept of assignment semantics.
4	To utilize high level data types such as lists and dictionaries.
5	To import and utilize a module and to perform read & write operations on files.

Course Outcomes:
Upon completion of the course, students shall have ability to

C103.1	Recognize the general principles and good Algorithmic problem solving.	[U]
C103.2	Read, write, execute by hand simple Python programs.	[U]
C103.3	Structure simple Python programs for solving problems.	[U]
C103.4	Decompose a Python program into functions.	[AP]
C103.5	Represent compound data using Python lists, tuples and dictionaries.	[AP]
C103.6	Read and write data from data sheets and Analyse data.	[A]

Course Contents:

Laboratory Experiments:

1. Programs for Familiarizing with the syntax and basic concepts
2. Programs to perform various string operations
3. Implementing conditional, control and repetition statements.
4. Creating Functions and recursive functions.
5. Programs for Familiarizing File operations
6. Initializing Packages and implementing programs based on it
7. Creating and processing data files.
8. Implementing GUI using turtle
9. Loading Data with Numpy
10. Visualizing the data using matplot lib

Total Hours:45

Text Books:

1	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/think-python/)
2	Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python" – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3	Fabio Nelli, "Python Data Analytics: Data Analysis and science using pandas, matplotlib and python programming language", Apress.

Reference Books:

1	Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach", Pearson India Education Services Pvt. Ltd., 2016.

2	Timothy A. Budd, “Exploring Python”, Mc Graw Hill Education (India) Private Ltd., 2015.
3	John V Guttag, “Introduction to Computation and Programming Using Python’’, Revised and expanded Edition, MIT Press , 2013.
4	Peter Morgan, ”Data Analysis from scratch with python: Beginner guide using python, pandas, Numpy, SCIKIT-learn, IPython, TensorFlow and Matplotlib”, AI Sciences, 2018.
Web References:	
1	http://nptel.ac.in/courses/106106145/
2	https://www.codecademy.com/learn/learn-python
3	https://www.coursera.org/learn/python-data-analysis#syllabus
Online Resources:	
1	https://www.programiz.com/python-programming
2	https://www.fullstackpython.com/best-python-resources

Summative assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Continuous Assessment (60%)**		**End Semester Examination (40%)**
	FA (45 Marks)	**SA (15 Marks)**	**Practical Examination (40 Marks)**
Remember	10	10	10
Understand	20	20	20
Apply	40	40	40
Analyse	30	30	30
Evaluate			
Create			

Mapping of Course Outcomes (CO) with Programme Outcomes(PO) and Programme Specific Outcomes(PSO)

COs	**POs**												**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
C103.1	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3
C103.2	3	3	3	3	2	2	2	3			2	3	3	3	2
C103.3	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C103.4	3	3	3	3	2	2	2	3			2	3	2	2	3
C103.5	3	3	2	2	3	3	3	3			2	2	3	3	
C103.6	3	3	2	2	3	3	3	3			2	2	3	3	3

21ME103	ENGINEERING PRACTICES LABORATORY	0/0/3/1.5
Nature of Course	Practical application	
Pre Requisites	Nil	

Course Objectives:

1	To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience in Carpentry, Sheet metal, Plumbing, Welding and Foundry.
2	To learn about basic electrical devices, meters and electronics devices and to gain knowledge about the fundamentals of various electrical and electronic gadgets their working and trouble shooting.

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Identify and solve the basic engineering problems at home and in workplace.	[AP]
C103.2	Develop the surfaces and make simple components like tray and funnel.	[C]
C103.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C103.4	Prepare pipe connections and sand moulds.	[AP]
C103.5	Understand the fundamentals of hot forging and injection moulding	[U]
C103.6	Examine and troubleshoot electrical and electronic circuits	[A]

Course Contents:

GROUP A (CIVIL & MECHANICAL)

Manufacturing Methods –Sheet metal operations – Welding – arc welding, gas welding, Study of TIG & MIG welding. Study of foundry, Demonstration of Smithy and Injection moulding – Carpentry work using power tools – Plumbing components and pipelines

List of Experiments:

S.No	List of Experiments	CO Mapping	RBT
1	Preparation of butt joints and lap joints using arc welding	C103.3	[AP]
2	Sheet metal Forming and Bending, Model making – Trays and funnels.	C103.2	[C]
3	Preparation of wooden joints by sawing, planning and cutting.	C103.3	[AP]
4	Making basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings.	C103.4	[AP]

5	Demonstration of foundry operations like mould preparation for solid and split piece pattern.	C103.4	[U]
6	Demonstration of Smithy operations	C103.5	[AP]
7	Demonstration of assembly of pump / Demonstration of Injection moulding	C103.5	[AP]

GROUP B (ELECTRICAL AND ELECTRONICS ENGINEERING)

List of Experiments:

Basic Circuit Elements: Resistor, inductor, capacitor. Introduction to measuring equipments: Moving iron meter, moving coil meter, Wattmeter, Energy meter, CRO, Multi-meter. Digital logic circuits, PCB design, fuse, relay, circuit breaker, wire, Earthing, fan, fluorescent lamp, iron box, mixer grinder, study of FM radio and mobile phone.

S.No.	List of Experiments	CO Mapping	RBT
1	Study and identification of electronic components with specification.	C103.6	[U]
2	Testing of CRO and Electronic components using Multimeter.	C103.6	[A]
3	Generation and measurement of signals using CRO.	C103.6	[A]
4	Familiarisation of digital basic gate IC's.	C103.6	[AP]
5	Soldering practice-components devices and circuits-using general purpose PCB.	C103.6	[AP]
6	Demonstration of meters and electrical components.	C103.6	[AP]
7	Safety precautions with electrical components.	C103.6	[AP]
8	Residential house wiring.	C103.6	[A]
9	Measurement of power and energy.	C103.6	[A]
10	Trouble shooting of electrical equipments.	C103.6	[A]

Total Hours:45

Reference Books:

1	Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Pearson Education, Inc. 2009 (Second Indian Reprint).
2	Hajra Choudhury, "Elements of Workshop Technology", Vol. I & II, Media Promotors Pvt Ltd., 2014.

3	Suyambazhagan S, 'Engineering practices' PHI Learning private limited, New Delhi, 2012.
4	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
5	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.

Web References:

1	www.nptel.ac.in
2	www.sme.org
3	http://www.allaboutcircuits.com/education/

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Rubric based Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Remember	10	10
Understand	10	10
Apply	40	40
Analyze	20	20
Evaluate	10	10

Mapping of Course Outcomes (CO) with Programme Outcomes(PO) and Programme Specific Outcomes(PSO)

COs	POs												PSOs		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
C103.1	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3
C103.2	3	3	3	3	2	2	2	3			2	3	3	3	2
C103.3	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C103.4	3	3	3	3	2	2	2	3			2	3	2	2	3
C103.5	3	3	2	2	3	3	3	3			2	2	3	3	
C103.6	3	3	2	2	3	3	3	3			2	2	3	3	3

21GE201	UNIVERSAL HUMAN VALUES	3 /0 /0 /3
Pre requisites	Interpersonal Communication and Value Sciences	

Course Objectives:

1	Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2	Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
3	Strengthening of self-reflection.
4	Development of commitment and courage to act.
5	Helping the students to appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
6	Highlighting plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Course Outcomes:
Upon completion of the course, students shall have ability to

C201.1	Understand about themselves and their surroundings (family, society, nature).	[U]
C201.2	Understand and take responsibilities in life and handle problems to attain sustainable solutions while keeping human relationships and human nature in mind.	[U]
C201.3	Apply responsibilities towards their commitments (human values, human relationship and human society).	[AP]
C201.4	Apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.	[AP]
C201.5	Analyse ethical and unethical practices, and formulate strategies to actualize a harmonious environment wherever they work.	[AN]
C201.6	Understand the harmony in nature and existence, and work out mutually on fulfilling participation in the nature.	[U]

Course Contents:

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education, Understanding Harmony in the Human Being - Harmony in Myself! 15Hours

Purpose and motivation for the course. Self-Exploration–Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Understanding human being as a co-existence of the sentient 'I' and the 'Material Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical Facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'.

Understanding the harmony of 'I' with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail-Programs to ensure Sanyam and Health.

Module 2: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship, Understanding Harmony in the Nature and Existence - Whole existence as Coexistence 15Hours

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and Competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Understanding the harmony in the Nature. Interconnectedness and mutual fulfilment among the four orders of nature recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.

Module 3: Implications of the above Holistic Understanding of Harmony on Professional Ethics 15Hours

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems. Case studies of typical holistic technologies, management models and eco-friendly production systems. Strategy for transition from the present state to Universal Human Order: a. Individual level: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.

Total Hours:30

Text Books:	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010
2	Rajni Setia, Priyanka Sharma, " Human Values", Genius Publication", Jaipur,2019.
Reference Books:	
1	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
3	India Wins Freedom - Maulana Abdul Kalam Azad.
Web References:	
1	https://examupdates.in/professional-ethics-and-human-values/
2	http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
3	https://www.yourmorals.org/schwartz.2006.basic%20human%20values.pdf
Online Resources:	
1	https://nptel.ac.in/courses/109/104/109104068/
2	https://medium.com/the-mission/the-12-important-life-skills-i-wish-id-learned-in-school-f4593b49445b

3	https://www.thebalancecareers.com/life-skills-list-and-examples-4147222

Summative assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%)						**End Semester Examination (60 %)**
CA 1 (20 Marks)			**CA 2 (20 Marks)**			**Theory Examination (60 Marks)**
SA 1 (12 Marks)	**FA 1**		**SA 2 (12 marks)**	**FA 2**		
	Component -I (4 marks)	**Component –II (4 marks)**		**Component -III (4 marks)**	**Component -IV (4 marks)**	

Assessment Methods & Levels (based on Blooms'Taxonomy)				
Formative assessment based on Capstone Model (16%)				
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)**		**Marks**
C201.1	Understand & Apply	Component - I	Pre-Test and Post -Test	4
C201.2	Understand & Apply	Component - II	Online Quiz	4
C201.3	Understand & Apply	Component - III	Buddy Program	4
C201.4				
C201.5	Apply	Component - IV	Seminar	4
C201.6				

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (24%)**		**End Semester Examination (60%) [60 Marks]**
	CIA1 [12 Marks]	**CIA2 [12 Marks]**	
Remember	10	10	10
Understand	10	20	20
Apply	40	40	40
Analyse	40	30	30
Evaluate	-	-	-
Create	-	-	-

Mapping of Course Outcomes (CO) with Programme Outcomes(PO) and Programme Specific Outcomes(PSO)

COs	**POs**												**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
C201.1	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3
C201.2	3	3	3	3	2	2	2	3			2	3	3	3	2
C201.3	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C201.4	3	3	3	3	2	2	2	3			2	3	2	2	3
C201.5	3	3	2	2	3	3	3	3			2	2	3	3	
C201.6	3	3	2	2	3	3	3	3			2	2	3	3	3

21MA201	ENGINEERING MATHEMATICS II	2/1/2/4
Nature of Course	J (Problem analytical)	
Pre requisites	Concepts of Differentiation and Integration.	

Course Objectives:

1	To gain knowledge in integrals, which are needed in engineering applications.
2	To develop logical thinking and analytical skills in evaluating multiple integrals.
3	To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines.
4	To impart the knowledge of Laplace transform, to find solutions of initial value problems for linear ordinary differential equations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Determine the area and volume by applying the techniques of double and triple integrals.	[R]
C201.2	Finding the values of integrals through different numerical methods.	[U]
C201.3	Differentiate and integrate a vector-valued functions to solve real world applications.	[AP]
C201.4	Calculate grad, div, curl and use Gauss, Stokes and Greens theorem to simplify the calculations of integrals.	[AP]
C201.5	Apply Laplace transform techniques in system modelling, digital signal processing, process control, solving boundary value problems.	[AP]
C201.6	Apply Laplace transform methods for solving linear differential equations.	[AP]

Course Contents:

INTEGRAL CALCULUS: (18 Hrs)

Definite integrals: Evaluation of definite integrals using Bernoulli's formula –Multiple Integrals: Double integration in Cartesian coordinates –Area as double integral –Change of order of Integration – Triple integration in Cartesian co-ordinates –Volume as triple integral –Beta and Gamma functions – Relation between Beta and Gamma Functions – Evaluation of Integrals using Beta and Gamma Functions – Numerical integration: Trapezoidal rule and Simpson's rule for single and double integrals.

VECTOR CALCULUS: (14 Hrs)

Vector differential operator – Gradient of a scalar point function - Directional derivatives –Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields –Simple problems – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (theorems statements only)– Simple applications involving cubes and rectangular parallelepipeds.

LAPLACE TRANSFORM: (16 Hrs)

Convergence of Laplace transform – Transform of some standard functions –Unit step function – Unit Impulse function – Properties – Initial and final value theorem – Inverse Laplace transform – Partial fraction method – Convolution theorem – Application of Laplace transform for solving second order ordinary differential equation.

Lab Components:

1. Double integrals evaluation in cartesian coordinates using MATLAB.
2. Triple integral calculations using MATLAB in cartesian and cylindrical coordinates.
3. Double integral evaluation in MATLAB by Trapezoidal rule.
4. Evaluation of gradient, curl and divergence in MATLAB.
5. Line integral over a vector field using MATLAB
6. Applying Green's theorem to solve integrals in MATLAB.
7. Relation between Laplace transform of function and its derivative using MATLAB.
8. Laplace transform of Dirac delta and Heaviside functions in MATLAB.
9. Solving Differential Equations in MATLAB using Laplace Transform.
10. Inverse Laplace Transform of symbolic expressions using MATLAB.

Total Hours:(48+12): 60

Text Books:

1	G.B.Thomas and R.L.Finney, Calculus and Analytic Geometry, 14thEdition, Pearson, Reprint,2018.
2	Kreyszig. E, "Advanced Engineering Mathematics" Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2018.
3	Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.

Reference Books:

1	Veerarajan. T, "Engineering Mathematics II",Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.

2	Glyn James, —Advanced Modern Engineering Mathematics, Pearson Education, 4th edition, 2012.
3	N.P.Bali and Dr.ManishGoyal,"A Text book of Engineering Mathematics" 9th edition, Laxmi publications ltd, 2014.
Web References:	
1	http://nptel.ac.in/video.php?subjectId=122107037
2	http://nptel.ac.in/courses/122107036/
3	http://nptel.ac.in/video.php?subjectId=117102060
Online Resources:	
1	https://www.coursera.org/learn/pre-calculus
2	https://www.coursera.org/learn/linearalgebra1
3	https://alison.com/courses/Advanced-Mathematics-1
4	https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.

Summative assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Examination (50%)**
CA 1 (10 Marks)			**CA 2 (10 Marks)**			**Practical Exam (30 Marks)**	**Theory Examination (50 Marks)**
SA 1 (6 marks)	**FA 1**		**SA 2 (6 marks)**	**FA 2**		**FA (22 marks)** / **SA (8 marks)**	
	Component -I (2 marks)	**Component -II (2 marks)**		**Component -III (2 marks)**	**Component -IV (2 marks)**		

Assessment Methods & Levels (based on Blooms'Taxonomy) - Theory				
Formative assessment based on Capstone Model (8%)				
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)**		**Marks**
C201.1	Remember	Component – I	Quiz	2
C201.2	Understand	Component - II	Assignment	2
C201.3	Apply	Component - III	Seminar	2
C201.4	Apply			
C201.5	Apply	Component - IV	Tutorial	2

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (12%)**		**End Semester Examination (50%) [50 Marks]**
	CIA1 [6 Marks]	**CIA2 [6 Marks]**	
Remember	30	30	20
Understand	50	40	50

Apply	20	30	30
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative assessment based on Continuous and End Semester Examination – Practical

Bloom's Level	Continuous Assessment (30%)	
	FA (22 Marks)	SA (8 Marks)
Remember	20	20
Understand	30	30
Apply	50	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes(PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C201.1	2	2	2										2		
C201.2	2	1	2										1		
C201.3	3	3	2										2		
C201.4	3	3	2											1	
C201.5	3	3	2						2					2	
C201.5	3	3	2						2					2	

21EN101	TECHNICAL COMMUNICATION SKILLS	2/0/2/3
Nature of Course	: E (Theory Skill Based)	
Pre requisites	Basics of English Language	

Course Objectives:

1	To enhance learners' LSRW skills.
2	To develop effective communication skills.
3	To facilitate learners to acquire effective technical writing skills.
4	To prepare learners for placement and competitive exams.
5	To facilitate effective language skills for academic purposes and real-life situations.

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Remember language skills for technical communication.	[R]
C101.2	Apply communication skills in corporate environment.	[AP]
C101.3	Understand and communicate effectively in personal and professional situation.	[AP]
C101.4	Understand and analyse a variety of reading strategies to foster comprehension and to construct meaningful and relevant connections to the text.	[U]
C101.5	Apply technical writing skills to write letters, emails and prepare technical documents.	[AP]
C101.6	Apply language skills with ease in academic and real-life situations.	[AP]

Course Contents:

Listening and Speaking: (17 Hrs)

Introduction to Effective Communication- Basics of English Language - Importance of LSRW Skills - Self Introduction - Introducing Others - **Listening** to Short Conversations or Monologues - Listening to Speeches / Talks - Listening and Responding -- Longer Listening Tasks -Recognise Functions **Speaking**- Speaking about Giving Directions / Instruction - Talk about Preferences-Agree and Disagree - Giving Opinions - Speaking Practices by Giving Examples, Reasons and Additional Information- Short Talk on Business Topics- Non Verbal Communication- Presentation using Digital Tools- Effectiveness of Narration- Leadership, Conflict and Persuasion.

Reading: (13 Hrs)

Reading Short Texts - Skimming and Scanning - Comparing Facts and Figures - Reading and Understanding Specific Information in a Text - Cloze Reading - Identifying Reasons and Consequences Through Reading Practices - Comprehension - Collocations.

Grammar and Writing: (15 Hrs)

Parts of Speech- Tenses – Subject Verb Agreement - Sentence Structures - Connectives - Modal Verbs - Question Formation - If Conditionals- Active and Passive - Impersonal Passive Voice - Vocabulary Building - Business Vocabulary -- Synonyms, Antonyms – British and American Words - One Word Substitution- Identifying Common Errors. Writing Formal Letters (Accepting and Declining Invitations) - Writing Business Letters (Calling for Quotation, Seeking Clarification, Placing an Order and Complaint Letter) - Email Writing – Memo - Circular - Agenda and Minutes of the Meeting - Job Application Letter - Resume Writing - Paragraph Writing – Proof Reading and Editing--Technical

Instructions and Recommendations- Jumbled Sentences - Technical Definitions - Report Phrases - Report Writing - Technical Proposal - Transcoding (Bar Chart, Flow Chart).		
Lab Components		
1	Listening Comprehension	[E]
2	Pronunciation, Intonation, Stress and Rhythm	[E]
3	Situational Dialogues	[E]
4	Formal Presentation	[E]
5	Group Discussion	[E]
6	Interview Skills- Online and Offline	[E]
	Total Hours:	**60**
Text Books:		
1	Practical English Usage. Michael Swan. OUP. 1995.	
2	Remedial English Grammar. F.T. Wood. Macmillan.2007	
3	On Writing Well. William Zinsser. Harper Resource Book. 2001	
4	Dr. Sumanth S, English for Engineers, Vijay Nicole Imprints Private Limited 2015.	
Reference Books:		
1	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.	
2	Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.	
3	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press	
Web References:		
1	http://www.academiccourses.com/Courses/English/Business-English	
2	https://**steptest**.in	
Online Resources:		
1 2 3	https://www.coursera.org/specializations/business-english http://www.academiccourses.com/Courses/English/Business-English https://scoop.eduncle.com/one-word-substitution-list	

Summative assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CA 1 (10 Marks)			**CA 2 (10 Marks)**			**Practical Exam (30 Marks)**		**Theory Examination (50 Marks)**
SA 1 (6 Marks)	**FA 1**		**SA 2 (6 marks)**	**FA 2**		**FA (22 marks)**	**SA (8 Marks)**	
	Component -I (2 marks)	**Component -II (2 marks)**		**Component -III (2 marks)**	**Component -IV (2 marks)**			

Assessment Methods & Levels (based on Blooms'Taxonomy) - Theory				
Formative assessment based on Capstone Model (8%)				
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)**		**Marks**
C101.1	Understand	Component - I	Quiz	2
C101.2	Apply			
C101.3	Apply	Component - II	Impromptu speaking	2
C101.4	Understand			
C101.5	Apply	Component - III	Reading comprehension	2
C101.6	Apply	Component - IV	Group assignment	2

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (12%)**		**End Semester Examination (50%) [50 Marks]**
	CIA1 [6 Marks]	**CIA2 [6 Marks]**	
Remember	20	20	20
Understand	40	40	40
Apply	40	40	40
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative assessment based on Continuous and End Semester Examination - Practical		
Bloom's Level	**Continuous Assessment (30%)**	
	FA (22 Marks)	**SA (8 Marks)**
Remember	20	20
Understand	40	40
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C101.1									2	3		2			2
C101.2									3	3		1			1
C101.3								2	2	2		1			1
C101.4								1	1	2					1
C101.5								1	3	3		2			2
C101.6								1	3	3		2			2

21PH104	PHYSICS	3/0/3/4.5

Nature of Course	: E (Theory skill based)
Prerequisites	: Nil

Course Objectives:

1.	To learn the fundamental concepts of physics and apply this knowledge to both scientific and engineering problems.
2.	To make the students enrich basic knowledge in various fields such as Laser, Optical fibers, Photonics, Superconductors and quantum mechanics of physics and apply the same in computing fields.

Course Outcomes:

Upon completion of the course, students shall have the ability to

C104.1	Recall and interpret the basic concepts of lasers and various types of optical fibers for articulating in engineering applications.	[R]
C104.2	Describe and conduct experiments in photonic materials.	[U]
C104.3	Acquire basic understanding and fundamental concepts of superconductors.	[R]
C104.4	Discuss the dual nature of radiation and matter.	[U]
C104.5	Solve Schrodinger's equations on finite and infinite potential well problems.	[AP]
C104.6	Apply quantum idea for understanding the working of quantum computing.	[AP]

Course Contents:

Laser and Fiber optics: **(15 Hrs)**

Laser: Characteristics of laser – Principle of spontaneous emission and stimulated emission – Einstein's theory of matter radiation interaction and A and B coefficients (derivation) – Population inversion – Pumping –Nd-YAG and CO_2 laser – Applications: Laser printer, Data storage and Bar code scanner. ***Fiber optics:*** Light propagation through fibers, acceptance angle, numerical aperture –Types of fibers: step index, graded index, single mode and multimode– Optical fibers for computing applications–PC to PC communication and fiber optics in computer networking.

Photonics and Superconductors: (15 Hrs)

Photonics: Introduction to photonic materials – Photonic crystals – Liquid crystal display (LCD) Light sources: Light emitting diode (LED) –Photo dependence resistor– Photo detectors: PIN, avalanche – Photo voltaic effect, Solar cell – Applications of photonic materials in computing – optical computing. ***Superconductors:*** Properties of Superconductors: effect of magnetic field, Meissner effect, effect of current,

thermal properties, isotope effect, Josephson effects and its applications – Type–I and Type–II Superconductors –BCS theory–High T_C superconductors –Application of Superconductors: magnetic levitation, SQUID and cryotron.

Quantum Mechanics and Quantum computing: (15 Hrs)

Quantum Mechanics: Planck's quantum theory (derivation) – Matter waves, de-Broglie wavelength, Heisenberg's uncertainty principle –Schrödinger's wave equation: time independent and time dependent – Physical significance of wave function –Particle in a one-dimensional potential box– Electron microscope: SEM and TEM–Postulates of quantum mechanics. ***Quantum computing*****:** Introduction to quantum computing–qubits, entanglement, decoherence and quantum supermacy, differences in quantum and classical computation.

Lab Component		**30 Hours**
1	Particle size determination and measurement of d-spacing in CD using Laser.	[U]
2	Determination of wavelength, angle of divergence and coherence length of laser source.	[U]
3	Determination of numerical aperture and acceptance angle parameter of optical fiber using Laser source.	[U]
4	Characteristics curves of solar cell.	[U]
5	Characteristics curve of light dependent resistor (LDR).	[U]
6	Determination of bandgap of semiconductor.	[U]
7	Determination and verification of Stefan law.	[U]
8	Determination of Planck's constant using electroluminescence.	[U]
9	Determination of entangled photons using spectrometer.	[U]
10	Determination of wavelength of mercury spectrum – Spectrometer	[U]
	Life Skills Experiments	
1	How does a fuel (gas/liquid) pump nozzle shut off?	
2	How does a circuit breaker work?	
3	How to Check Earthing at Home?	
		Total Hours: 75

Text Books:	
1	Rajendran, V "Engineering Physics" Mc Graw Hill Publications ltd, New Delhi, 2016.
2	David Halliday, Robert Resnick, Jearl Walker "Fundamentals of Physics", 11th edition, Wiley, 2018.

Reference Books:	
1	William T. Silfvast “Laser Fundamentals” Cambridge University Press, 2012
2	FedorMitschke “Fiber Optics physics and Technology”, 2nd edition, Springer, 2017.
3	Chakrabarti P. “Optical Fiber Communication”, McGraw Hill Education,2015.
4	Kasap,Safa, Capper, “Handbook of Electronic and Photonic Materials” 2nd edition, Springer, 2017.
5	Balkan, Naci, Erol, Ayşe, “Semiconductors for Optoelectronics”, 1st edition Springer, 2020.
6	Bhattacharya D. K. and Poonam Tandon, “Engineering Physics”, Oxford University press, 2014
7	David J. Griffiths, “Introduction to Quantum Mechanics”, 2nd edition , Cambridge university press, 2017.
8	Chris Bernhardt, “Quantum Computing for Everyone” The MIT press, 2019

<table>
<tr><th colspan="8">Summative assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="7">Continuous Assessment (50%)</th><th rowspan="2">End Semester Examination (50%)</th></tr>
<tr><th colspan="3">CA 1 (10 Marks)</th><th colspan="3">CA 2 (10 Marks)</th><th colspan="2">Practical Exam (30 Marks)</th></tr>
<tr><th rowspan="2">SA 1 (6 Marks)</th><th colspan="2">FA 1</th><th rowspan="2">SA 2 (6 marks)</th><th colspan="2">FA 2</th><th rowspan="2">FA (22 marks)</th><th rowspan="2">SA (8 Marks)</th><th rowspan="2">Theory Examination (50 Marks)</th></tr>
<tr><th>Component -I (2 marks)</th><th>Component -II (2 marks)</th><th>Component -III (2 marks)</th><th>Component -IV (2 marks)</th></tr>
<tr><td colspan="8">Assessment Methods & Levels (based on Blooms’Taxonomy) - Theory</td></tr>
<tr><td colspan="8">Formative assessment based on Capstone Model (8%)</td></tr>
<tr><th>Course Outcome</th><th>Bloom’s Level</th><th colspan="4">Assessment Component (Choose and map components from the list – Quiz, Assignment, Case study, Seminar, Group Assignment)</th><th colspan="2">Marks</th></tr>
<tr><td>C104.1</td><td>Understand</td><td colspan="3">Component – I</td><td>Quiz</td><td colspan="2">2</td></tr>
<tr><td>C104.2</td><td>Remember</td><td colspan="3">Component - II</td><td>Assignment</td><td colspan="2">2</td></tr>
<tr><td>C104.3</td><td>Understand</td><td colspan="3" rowspan="2">Component - III</td><td rowspan="2">Seminar</td><td colspan="2" rowspan="2">2</td></tr>
<tr><td>C104.4</td><td>Understand</td></tr>
<tr><td>C104.5</td><td>Apply</td><td colspan="3">Component - IV</td><td>Tutorial</td><td colspan="2">2</td></tr>
<tr><td colspan="8">Summative assessment based on Continuous and End Semester Examination</td></tr>
<tr><th rowspan="2">Bloom’s Level</th><th colspan="4">Continuous Assessment (12%)</th><th colspan="3" rowspan="2">End Semester Examination (50%) [50 Marks]</th></tr>
<tr><th colspan="3">CIA1 [6 Marks]</th><th colspan="2">CIA2 [6 Marks]</th></tr>
<tr><td>Remember</td><td colspan="3">30</td><td colspan="2">30</td><td colspan="3">20</td></tr>
<tr><td>Understand</td><td colspan="3">50</td><td colspan="2">40</td><td colspan="3">50</td></tr>
<tr><td>Apply</td><td colspan="3">20</td><td colspan="2">30</td><td colspan="3">30</td></tr>
<tr><td>Analyse</td><td colspan="3">-</td><td colspan="2">-</td><td colspan="3">-</td></tr>
</table>

Evaluate	-	-	-
Create	-	-	-

Summative assessment based on Continuous and End Semester Examination – Practical

Bloom's Level	Continuous Assessment (30%)	
	FA (22 Marks)	SA (8 Marks)
Remember	20	20
Understand	30	30
Apply	50	50
Analyse	-	-
Evaluate	-	-
Create	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes(PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C104.1	2	1	1										1		
C104.2	1	1	1										1		
C104.3	2	1	2											2	
C104.4	2	1	2											2	
C104.5	3	2	3						1				2	2	
C104.6	3	2	3						1				2	2	

21AD201	DATA STRUCTURES USING C	3/0/2/4
Nature of Course	: F (Theory Programming)	
Pre requisites	: Fundamentals of Problem Solving	

Course Objectives:

1	To learn the features of C
2	To handle functions, pointers, structures, unions and files using C
3	To manipulate linear and non-linear data structures
4	To explore the applications of linear and non-linear data structures
5	To familiarize the concepts of hashing.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C201.1	Develop C programs for any real-world technical application using basic programming construct, arrays and strings	[AP]
C201.2	Apply advanced features of C in solving problems	[AP]
C201.3	Design applications using sequential and random-access file processing	[AP]
C201.4	Demonstrate operations like insertion, deletion, searching, traversing etc. on linear and non- linear data structures	[AP]
C201.5	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.	[AP]
C201.6	Choose appropriate data structure for any real-world data set.	[A]

Course Contents:

MODULE I: C PROGRAMMING: (15 Hrs)

Basic Features: Introduction -Data Types – Variables – Operations – Expressions and Statements – Conditional and Iterative Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays- Strings. ***Advanced Features:*** Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Storage classes - Preprocessor Directives.

MODULE II: LINEAR DATA STRUCTURES – LIST, STACK, QUEUE: (15 Hrs)

Abstract Data Types (ADTs) – List ADT – Array based implementation – Linked list implementation – Singly linked lists – Circularly linked lists – Doubly linked lists – Application of lists – Polynomial Manipulation. Stack ADT – Operations – Applications – Evaluating arithmetic expressions – Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – Applications of queues.

MODULE III: NON-LINEAR DATA STRUCTURES: (15 Hrs)

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Graphs- Breadth First traversal - Depth- first traversal- Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

Laboratory Component:

S.No.	List of Experiments
1.	Practice of C Programming using Branching and Iterative constructs.
2.	Programs using Functions and Arrays
3.	Programs using Structures and Pointers.
4.	Implementation of Stack using Arrays
5.	Implementation of Stack using Linked List.
6.	Implementation of Queue using Arrays
7.	Implementation of Queue using Linked List.
8.	Implementation of Binary Search Tree.
9.	Implementation of hashing techniques
	Total Hours: 60 Hours

Text Books:	
1	YashavantKanetkar, “Let us C”, 15th Edition, BPB Publications, 2017
2	ReemaThareja, “Programming in C”, 2nd Edition, Oxford University Press, 2016.
3	PradipDey and ManasGhosh, “Programming in C”, 2nd Edition, Oxford University Press, 2011.
4	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Pearson Education India, 3rd Edition 2013.
Reference Books:	
1	Ellis Horowitz, SartajSahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd Edition, University Press, 2008
2	Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, 1983.
3	Robert Kruse, C.L.Tondo, Bruce Leung, ShashiMogalla , “Data Structures and Program Design in C”, 2nd Edition, Pearson Education, 2007
4	Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, 2nd Edition, Tata McGraw-Hill, 1991.
5	Seymour Lipschutz, “ Data Structures by Schaum series”, 2nd Edition, Tata McGraw Hill, 2013.
Web References:	
1	http://www.nptel.ac.in
2	https://visualgo.net/en
Online Resources:	
1	https://www.youtube.com/watch?v=-CpG3oATGIs
2	http://lcm.csa.iisc.ernet.in/dsa/dsa.html
4	http://freevideolectures.com/Course/2519/C-Programming-and-Data-Structures
5	http://freevideolectures.com/Course/2279/Data-Structures-And-Algorithms

Assessment Methods & Levels (based on Blooms' Taxonomy) - Theory			
Formative Assessment based on Capstone Model (8%)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C201.1	Apply	Assignment – 1	2
C201.2	Apply	Quiz	2
C201.3, C201.4	Apply	Assignment – 2	2
C201.5	Apply	Case Study	2

Summative Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Internal Assessment (12%)**		**End Semester Examination (50%) [50 Marks]**
	CIA 1 [6 Marks]	**CIA 2 [6 Marks]**	
Remember	20	10	10
Understand	10	10	15
Apply	70	80	75
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Summative Assessment based on Continuous and End Semester Examination - Practical		
Bloom's Level	**Continuous Assessment (30%)**	
	FA (22 Marks)	**SA (8 Marks)**
Remember	10	10
Understand	20	10
Apply	70	80
Analyse	-	-
Evaluate	-	-
Create	-	-

Summative assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Examination (50%)**
CA 1 (10 Marks)			**CA 2 (10 Marks)**			**Practical Exam (30 Marks)**		**Theory Examination (50 Marks)**
SA 1 (6 Marks)	**FA 1**		**SA 2 (6 marks)**	**FA 2**		**FA (22 marks)**	**SA (8 Marks)**	
	Component -I (2 marks)	**Component -II (2 marks)**		**Component -III (2 marks)**	**Component -IV (2 marks)**			

Theory:

- SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
- FA1 & FA 2 is internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
- ES exams conducted and evaluated for 100 marks

Practical:

- FA - Performance based assessment observation and Record evaluated for 100 marks each experiment
- SA – Model Examination conducted and evaluated for 100 marks

COs	POs												PSOs		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
C201.1	3	3	1	1	2								3	1	2
C201.2	3	3	2	1	1								3	1	2
C201.3	3	3	1	2	1								3	2	3
C201.4	3	3	3	3	2								3	1	1
C201.5	3	3	3	3	2								3	1	1
C201.6	3	3	3	3	2								3	1	1
	3 Strongly agreed			2 Moderately agreed						1 Weakly agreed					

21ME111	ENGINEERING GRAPHICS	1/0/3/2.5

Nature of Course	Practical application
Pre - Requisites	Basic Drawing and Computer Knowledge

Course Objectives:

1	To know the method to construct the conic curves used in engineering applications.
2	To develop an understanding of Isometric to orthographic views and vice versa.
3	To learn the basic projection of straight lines and plane surfaces.
4	To develop the imagination of solids inclined to one reference plane.
5	To know the development of surfaces used in various fields.

Course Outcomes:

Upon completion of the course, students shall have ability to

C111.1	Understand the basic concepts of Engineering Graphics.	[U]
C111.2	Sketch isometric, orthographic projections and projection of lines and planes	[AP]
C111.3	Develop lateral surfaces of solids including prisms and pyramids	[AP]
C111.4	Construct projections of lines, planes, solids and isometric views using modelling software.	[A]

Course Contents:

Conic curves and special curves – Isometric projections, Isometric to orthographic projection-Orthographic to Isometric projection-Projection of lines and plane surfaces-Projection of solids-Development of surfaces-Introduction to perspective projection.

S.No	List of Experiments	CO Mapping	RBT
1	Introduction to drafting software.	C111.1	U
2	Construction of conic curves (Ellipse, Parabola and Hyperbola)	C111.1	U
3	Construction of special curves (Cycloid and Involutes)	C111.1	U
4	Isometric to orthographic projections – manual sketches	C111.2	AP
5	Isometric to orthographic projections – software sketches	C111.4	A
6	Projection of lines - inclined to HP, VP and Both HP & VP	C111.4	A
7	Projection of plane surfaces (Hexagon, Pentagon and circle) – inclined to any one of the principle planes	C111.4	A
8	Projection of solids (Prism and Pyramid) – inclined to HP	C111.3	AP

9	Projection of solids (Cone and Cylinder) – inclined to VP	C111.3	AP
10	Development of surfaces (Prism, Pyramid, Cone and Cylinder)	C111.4	A
11	Introduction to perspective projection	C111.2	U
			Total Hours:45

Reference Books:

1	Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2014.
2	K. V. Natarajan, "A Text Book of Engineering Graphics", Dhanalakshmi Publishers, 2018.
3	Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2011.
4	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2013.

Web References:

1	http://nptel.ac.in/courses/112102101/
2	www.solidworks.com

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%)**		**End Semester Examination (40%)**
	FA (45 Marks)	**SA (15 Marks)**	**Practical Examination (40 Marks)**
Remember	10	10	10
Understand	20	20	20
Apply	40	40	40
Analyse	30	30	30
Evaluate			
Create			

Course Outcome (CO)		**Programme Outcomes (PO)**											**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C111.1	2	2	1				2	2	3			2	3	2	
C111.2	2	2	1				2	2	3			2	3	2	
C111.3	2	2	1				2	2	3			2	3	2	
C111.4	2	2	1				2	2	3			2	3	2	

21AD301	ARTIFICIAL INTELLIGENCE PRINCIPLES AND TECHNIQUES	3 / 0 / 0 / 3
Nature of Course:	H (Theory technology)	
Pre requisites:	NIL	

Course Objectives:

1	To understand the main approaches to artificial intelligence.
2	To Explore areas of application based on knowledge representation.
3	To Develop abilities to apply, build and modify decision models to solve real problems.
4	To Familiarize the Artificial Intelligence techniques for building well-engineered and efficient intelligent systems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C301.1	Understand the importance of agents with its types.	[U]
C301.2	Analyze the various search strategies in the problems.	[AN]
C301.3	Explain the knowledge representation, problem solving, and learning methods of artificial intelligence.	[U]
C301.4	Analyze the knowledge of AI applications.	[AN]
C301.5	Understand the basics of an expert system.	[U]

Course Contents:

Overview of Artificial Intelligence and Agents: Introduction to AI, Types of AI, Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal-based agents, utility-based agents, learning agents. **Problem Solving:** Defining the problem as state space search, production system, problem characteristics and issues in the design of search programs.Problem solving agents, searching for solutions.

Search techniques: Uninformed search strategies: breadth first search, depth first search, depth limited search, bidirectional search. Heuristic search strategies: Greedy best-first search, A* search, AO* search, memory bounded heuristic search, Optimization problems: Hill climbing search, simulated annealing search, local beam search. **Constraint satisfaction problems:** Adversarial search,optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, iterative deepening. **Knowledge & reasoning:** Knowledge representation issues, representation, approaches to knowledge representation.

Representing Knowledge: Using predicate logic, representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Representing knowledge using rules, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning. **Probabilistic reasoning:** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques. **Expert Systems**: Architecture, Roles of Expert System.

Total Hours: 45

Text Books:

1.	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.
2.	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007.

Reference Books:

1.	Rich E, Knight K, Nair S B, Artificial Intelligence, 3rd edition, Tata McGraw-Hill, 2009.
2.	Luger George F, Artificial Intelligence: Structures and Strategies for Complex problem solving, 6th edition, Pearson Education, 2009.

3.	Carter M, Minds and Computers: An Introduction to the Philosophy of Artificial Intelligence, Edinburgh University Press, 2007.
4.	Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.
Web References:	
1.	http://www.nptelvideos.in/2012/11/artificial-intelligence.html
2.	https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_expert_systems.htm
3.	https://nptel.ac.in/courses/106105077/
Online Resources:	
1.	https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_agents_and_environments.htm
2.	https://www.geeksforgeeks.org/artificial-intelligence-an-introduction/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C301.1	Understand	Quiz	20
C301.2	Analyze	Tutorial	20
C301.3	Understand	Group Assignment	20
C301.4	Analyze		
C301.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C301.1	2			1						1			3	1	
C301.2	2	1	1	1						1	1		2	2	
C301.3	2	1	1	1						1	1		1	2	
C301.4	2	1	1	1						2	2		2	1	
C301.5	2	1	1	1						1	1		1	1	

21MA302	MATHEMATICAL STRUCTURES	3/1/0/4
Nature of Course	J (Problem analytical)	
Prerequisites	Higher secondary mathematics	

Course Objectives:

1	To study the concepts needed to test the logic of a program.
2	To learn the working on class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
3	To use number theory in computer networks and security.
4	To acquire thorough knowledge of fundamental notions from lattice theory and properties of lattices.

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Recall the basic concepts of logic, Sets, Relations, Functions and Number theory.	[R]
C302.2	Acquire critical thinking skills by understanding the logical structure of the language.	[U]
C302.3	Use the concepts of Discrete Mathematics in software development and hardware design.	[AP]
C302.4	Demonstrate the fundamental Concepts of sets, relations, mathematical functions and all of its properties.	[AP]
C302.5	Apply discrete mathematics in formal representation of various computing constructs and algebraic structures.	[AP]
C302.6	Apply integrated approach to number theory.	[AP]

Course Contents:

Module 1: Propositional and Predicate Calculus **20 hrs**

Propositional Calculus: Basic concepts – Propositions - Connectives– Truth tables – Tautologies and Contradictions –Contrapositive – Logical equivalences and Implications – Normal forms – Principal conjunctive and Disjunctive normal forms– Rules of inference – Validity of arguments –**Predicate Calculus**: Statement function – Variables – Free and bound variables – Quantifiers– Universe of discourse – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

Module 2: Set Theory **20 hrs**

Sets: Basic sets - Operations on Sets – Law on Sets - Cartesian product of sets – **Relations**: Types of relations and their properties– Relational matrix and graph of a relation – Equivalence relations – Partial ordering-**Functions:** Classification of functions–Composition of functions–Inverse function- **Counting**: Permutations and Combinations.

Module 3: Lattices and Number Theory **20 hrs**

Lattices: Partially ordered sets - Hasse diagram - Lattices and their properties - **Number Theory:** Division algorithm -Base-b representations - Number patterns-Prime and composite numbers-GCD-Euclidean algorithm-Fundamental theorem of arithmetic-LCM-Wilson's Theorem-Fermat's Theorem-Tau and Sigma Function.

Total Hours: 60

Text Books:

1	Tremblay J.P and Manohar R, —Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011
2	Kenneth H.Rosen, —Discrete Mathematics and its Applications, Seventh Edition, Tata McGraw – Hill Pub. Co. Ltd., New Delhi, Seventh Edition, 2017.
3	Koshy .T-"Elementary Number Theory with Applications. Elsevier Publications, New Delhi,Second Edition, 2007.

Reference Books:

1	Ralph.P.Grimaldi, —Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education Asia, New Delhi, Fifth Edition, 2019.
2	Bernard Kolman, Robert C. Busby, Sharan Cutler Ross, —Discrete Mathematical Structures, sixth edition , Pearson Education Pvt Ltd., New Delhi, 2017
3	Thomas Koshy, —Discrete Mathematics with Applications, Elsevier Publications, 2004.
4	David Houcque-Introduction to MATLAB for Engineering Students -2005

Web References:

1	https://nptel.ac.in/courses/111/107/111107058/
2	https://nptel.ac.in/courses/106/106/106106094/
3	https://nptel.ac.in/courses/106/106/106106183/
4	https://nptel.ac.in/courses/111/101/111101137/

Online Resources:

1	http://discrete.openmathbooks.org/dmoi3.html
2	https://www.csie.ntu.edu.tw/~sylee/courses/dm/resources.htm
3	https://www.maa.org/press/ebooks/resources-for-teaching-discrete-mathematics

Continuous Assessment				End Semester Examination	Tota l
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C302.1	Remember	Quiz	20
C302.2	Understand	Seminar	20
C302.3 – C302.6	Apply	Tutorial	20
C302.3 – C302.6	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C302.1	1	1		1	1								1		
C302.2	2	2		2	2								1		
C302.3	3	3		3	3								1		
C302.4	3	3		3	3								1		
C302.5	3	3		3	3								1		
C302.6	3	3		3	3								1		

21AD302	ANALYSIS OF ALGORITHMS	3 / 0 / 2 / 4
Nature of Course:	I (Problem Concepts)	
Pre requisites:	Data Structures	

Course Objectives:

1	To understand the techniques for analyzing the computer algorithms.
2	To learn the paradigms for designing the algorithms.
3	To analyze the efficiency of various algorithm design techniques / paradigms for the same problem.
4	To understand the graphical algorithms for solving problems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C302.1	Illustrate the searching and sorting algorithms.	[U]
C302.2	Interpret the design principles of greedy and pattern searching algorithms with examples.	[AP]
C302.3	Explain the problem-solving methodology used in Backtracking.	[A]
C302.4	Analyze the time and space complexities of dynamic programming strategy in solving complex problems	[A]
C302.5	Employ range query and graph algorithms in real world problems.	[AP]

Course Contents:

Sorting, Searching and String Algorithms: **[15 Hours]**

Searching & Sorting, Divide and Conquer – Bubble sort, Insertion sort, Selection sort, Binarysearch, quick sort, merge sort - Heaps & Hashing – Binary heap, heap sort - Greedy Algorithms – Activity selection problem, Fractional knapsack - String algorithms - Naive algorithm, Rabin Karp algorithm, KMP algorithm, Z algorithm, Manachers algorithm - Tries - Making a trie node, Insert, Search and Remove operation in Tries, Huffman coding.

Greedy and Dynamic Programming: **[15 Hours]**

Backtracking - Rat in a maze, Permutation and Combination, N Queen problem and Problemson Backtracking, Knight's Tour Problem, Subset Sum, M-Coloring Problem, Hamiltonian Cycle Problem, Sudoku Solver, Sieve of Sundaram, Prime Numbers after P with Sum S. Dynamic Programming - Greedy vs Dynamic programming, Top down and bottom-up approach, Longest Common Subsequence, Longest increasing subsequence, Edit distance, 0-1 Knapsack, Coin change problem, Minimum Cost Path, Subset Sum Problem, Maximum Size Square Sub Matrix with all 1s, Longest Palindromic Subsequence.

Tree and Graph Algorithms: **[15 Hours]**

Range query Algorithms - Range Minimum Query (Brute Force Approach). Segment Tree, Range Minimum Query on the Constructed Segment Tree, Range Minimum Query Using Sparse Table. Graph Algorithms - Dijkstra's Algorithm, Floyd warshall Algorithm, Kruskal's Algorithm for Minimum Spanning Tree, Prim's Algorithm for Minimum Spanning Tree.

	Total Hours:	**45**
Lab Component		
1	Implementation of Linear, Binary Search and Tries.	
2	Implementation of Sorting Algorithms - Bubble, Insertion, Selection, Merge Sort, Quick sort, Heap Sort.	
3	Implementation of Greedy Algorithms.	
4	Implementation of Pattern Searching Algorithms.	
5	Implementation of Backtracking Algorithms.	
6	Implementation of Dynamic Programming.	
7	Implementation of Range Query Algorithms.	
8	Implementation of Minimum Spanning Tree.	
9	Implementation of Shortest path Algorithms.	
10	Implementation of Maximum Flow Minimum cut Algorithm.	
	Total Hours:	**30**
Text Books:		
1.	Anany Levitin, “Introduction to Design and Analysis of Algorithms”, Pearson Publications, 3rd Edition, 2012.	
2.	Thomas H.Cormen, Charles E.Leiserson, R.L.Rivest, “Introduction to Algorithms”, Prentice Hall of India Publications, 3rd Edition, 2009.	
Reference Books:		
1	Ellis Horowitz, Sartaj Sahni and SanguthevarRajasekaran, “Computer Algorithms/ C++”, 2nd Edition, Universities Press, 2019.	
2	Sara Baase and Allen Van Gelder, “Computer Algorithms: Introduction to Design and Analysis”, Pearson Publications, 3rd Edition, 2008.	
Web References:		
1	https://www.cs.usfca.edu/~galles/visualization/Algorithms.html	
2	https://www.coursera.org/learn/introduction-to-algorithms	
3	https://timroughgarden.org/videos.html	
Online Resources:		
1	https://onlinecourses.nptel.ac.in/noc19_cs47/preview	
2	https://www.csa.iisc.ac.in/~barman/daa18/E0225.html	
3	https://freevideolectures.com/course/2281/design-and-analysis-of-algorithms	

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C302.1	Understand	Quiz & Assignment	**20**
C302.2	Apply	Assignment	**20**
C302.3	Analyze	Case study	**20**
C302.4	Analyze	Group Assignment	**20**
C302.5	Apply		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination			
Continuous Assessment (50%)			**End Semester Examination (50%)**
CA 1 (100 Marks)	**CA 2 (100 Marks)**	**Practical Exam (100 Marks)**	**Theory Examination**

SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	(35%) Practical Examination (15%)
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C302.1	3	3	3	1	3	2	2	1	2		2	1	3	2	2
C302.2	3	3	3	1	3	2	2	1	2			1	3	2	2
C302.3	3	3	3	1	3	2	2	1	2		1	1	3	2	2
C302.4	3	3	3	1	3	2	2	1	2			2	3	2	2
C302.5	3	3	3	1	3	2	2	1	2			2	3	2	2

21IT301	WEB DEVELOPMENT USING REACT	3/0/2/4
Nature of Course	F (Theory programming)	
Pre requisites	Nil	

Course Objectives:

1.	To discuss the essence of front-end development skills.
2.	Ability to understand and use JavaScript in client-side web applications.
3.	To impart the knowledge of React components used in web application development platforms.
4.	To deploy and test the React App used in Web Applications.

Course Outcomes

Upon completion of the course, students shall have ability to

C301.1	Demonstrate the client-side JavaScript application development and the React library.	[U]
C301.2	Illustrate the single page applications in React.	[U]
C301.3	Utilize the various React features including components and forms.	[AP]
C301.4	Show the functionality of front-end UI applications using React.	[R]
C301.5	Apply CSS for designing responsive React applications.	[AP]
C301.6	Identify the use Redux-Redux and Axios package.	[AP]

Course Contents:

Module - I: **[15 Hours]**

JavaScript Essentials, How JavaScript works, Event loop, Stack, Heap and Queue, Node.js Fundamentals, Introduction to Node.js, Why Node.js?, Traditional Programming Limitations, React Introduction, Overview of frameworks, libraries for client side Web applications, Understanding "what" and "why" React, React Component Demonstration using code pen, Environment Setup for React Application. Understanding NPM commands, Using VS Code, VS Code extensions for ES6, React(formatting and check styles), Hello world app in React, React Essential Features and Syntax, React App Project Directory Structure, Overview of Webpack, Babel, React Component Basic, Create React Component, Understanding JSX, Limitations of JSX, Working with Components and Reusing Components.

Module - II: **[15 Hours]**

React Components - Props and State, Understanding and using Props and State, Handling Events with methods, Manipulating the State, Two way data-binding, Functional (Stateless) VS Class (Stateful) Components, Parent – Child Communication, Dynamically rendering contents, Showing Lists, List and keys, Styling Components, CSS Styling, Scoping Styles using Inline Styles, Limitations of inline styles, Inline Styles with Radium, Google Material UI, Installing Material UI, Material UI AppBar, Material UI's Toolbar, Custom React NavBar. CSS - Material UI Buttons, Using Material UI - Rendering a Button, Material UI Card, Material UI Checkbox, Material UI Grid Component, Material UI IconButton, Material UI Paper Component, Style Material UI Components with my own CSS, UI Templates for Business, Typography Usage, Debugging React Apps, Understanding React Error Messages, Handling Logical Errors, Debugging React apps using google developer tools and React DevTool. Understanding Error Boundaries, React Component life cycle, Updating life cycle hooks, Pure Components, React's DOM Updating Strategy, Returning adjacent elements, Fragments, React Component in Details, Higher Order Components, Passing unknown Props, Validating Props, Using References, React Context API, Updated LifeCycle hooks (16.3)

Module – III: **[15 Hours]**

React Projects, Demo apps, HTTP Requests/Ajax Calls, HTTP Requests in React, Introduction of Axios package, HTTP GET Request, fetching & transforming data, HTTP POST, DELETE, UPDATE, Handing Errors, Adding/Removing Interceptors, Creating/Using Axios instances, Redux, React Thunk, Difference between Thunk & other, React hooks, Application Using React & Redux , React Routing, Routing and SPAs, Setting Up the Router Package, react-router vs react-router-dom, Preparing the Project For Routing, Switching Between Pages. Routing-Related Props, The "withRouter" HOC & Route Props, Passing & extracting route/query parameters, Using Switch to Load a Single Route, Navigating Programmatically. React Forms and Form Validation, Creating a Custom Dynamic Input Component, Setting Up a JS Config for the Form, Dynamically Create Inputs based on JS Config, Adding a Dropdown Component. Handling User Input, Handling Form Submission, Adding Custom Form Validation, Fixing a Common Validation, Adding Validation Feedback, Showing Error Messages, Handling Overall Form Validity, Deploying React App to the Web, Testing React apps with Jasmine & implementing JEST.

Total Hours	**45**

Lab Component:

S. No.	List of Experiments
1	Create a Stateless Functional Component
2	Create a Stateful Class Component
3	Implementation of Conditional Rendering using Class Component
4	Implementation of Communication (Parent-child) between Components
5	Create material UI Card using React
6	Design a Custom Navigation bar using React
7	Implementation of React component to handle HTTP requests
8	Implementation of a Dropdown component using React
9	Implementation of Routing in React
10	Implementation of FORM validation in React
Total Hours:	**30**

Text Books:

1.	Robin Wieruch , “The Road to React”, 2022 Kindle Edition.
2.	Alex Banks,Eve Porcello. “Learning React: Modern Patterns for Developing React Apps”, O'Reilly Media,2020.
3.	Adam Bouch, “React and React Native”, Packt Publishing,3rd Edition, 2020.
4.	Kirupa Chinnathambi , “Learning React : A Hands-On Guide to Building Web Applications Using React and Redux”, Pearson Education, Second Edition,2018.

Reference Books:

1.	Adam Boduch, Roy Derks “React and React Native: A Complete Hands-on Guide to Modern Web and Mobile Development with React.js”, Packt Publishing, 2020.
2.	Carlos Santana Roldan, “React Cookbook”, Packt Publishing,2018.
3.	Lionel Lopez, “React: Quickstart Step-by-step Guide to Learning React Javascript Library (React.js, Reactjs, Learning React Js, React Javascript, React Programming)”, CreateSpace Independent Publishing Platform,2017.

Web References:	
1.	https://www.coursera.org/learn/front-end-react
2.	https://www.geeksforgeeks.org/full-stack-development-with-react-node-js-live/
3.	https://www.edx.org/learn/front-end-web-development
4.	https://www.w3schools.com/REACT/DEFAULT.ASP
Online Resources:	
1.	https://reactjs.org/
2.	https://www.youtube.com/watch?v=3HMtarQAt3A
3.	https://frontendmasters.com/guides/front-end-handbook/2018/what-is-a-FD.html
4.	https://www.youtube.com/watch?v=HT82p_re-EY

Continuous Assessment									End Semester Examination	Total
Theory				Practical			Total (A+B)	Total Continuous Assessment		
Formative Assessment	Summative Assessment	Total	Total (A)	Formative Assessment	Summative Assessment	Total (B)				
80	120	200	100	75	25	100	200	50	50	100

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C301.1	Understand	Quiz & Assignment	**20**
C301.2	Understand	Assignment	**20**
C301.3	Apply	Case study	**20**
C301.4	Apply	Group Assignment	**20**
C301.5, C301.6	Apply		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-

Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		**Theory Examination (35%)** **Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C301.1	3	3	3	2	2				2	2	2	2	3	3	2
C301.2	3	3	3	2	2				2	2	2	2	3	2	3
C301.3	3	3	3	3	2				3	2	2	2	3	2	2
C301.4	3	3	3	2	3				2	2	2	2	3	3	3
C301.5	3	3	3	2	3				2	2	2	2	3	3	3
C301.6	3	3	3	2	3				3	2	3	2	2	2	2

21CS302	JAVA PROGRAMMING	3/0/2/4
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	
Course Objectives:		
1	To learn the object oriented concepts using java programming.	
2	To analyze the types of constructor, inheritance and polymorphism.	
3	To apply the concepts of package, abstract class and interface.	
4	To apply the concepts of exception handling mechanisms in real time problems.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C302.1	Construct the Java programs using class, access modifiers, condition and looping statements.	[AP]
C302.2	Implement the java programs using string class, files and serialization concepts.	[AP]
C302.3	Develop the programs using object-oriented concepts such as inheritance, abstraction, interface and packages.	[AP]
C302.4	Classify the usage of different keywords based on its functionality and use the concepts of association, composition and aggregation for programming.	[A]
C302.5	Construct the program using polymorphism and exception handling mechanisms to solve real time problems.	[AP]

Course Contents:

Module 1: **15 Hours**

Identifiers & JavaBeans, Legal Identifiers, Sun's Java Code Conventions, JavaBeans Standards, Declare Classes, Source File Declaration Rules, Class Declarations and Modifiers, Concrete Subclass, Declaring an Interface, Declaring Interface Constants, Declare Class Members, Access Modifiers, Nonaccess Member Modifiers, Constructor Declarations, Variable Declarations, Declaring Enums. An Overview of the Wrapper Classes, Creating Wrapper Objects, Using Wrapper Conversion Utilities, Autoboxing. if and switch Statements, if-else Branching, switch Statements, Loops and Iterators, using while Loops, Using do Loops, Using for Loops, using break and continue, Unlabelled Statements, Labelled Statements.

Module 2 **15 Hours**

String, StringBuilder, and StringBuffer, The String Class, Important Facts About Strings and Memory, Important Methods in the String Class, The StringBuffer and StringBuilder Classes, Important Methods in the StringBuffer and StringBuilder Classes, File Navigation and I/O, Types of Streams, The Byte-stream I/O hierarchy, Character Stream Hierarchy, Random Access File class, The java.io.Console Class, Serialization, Dates, Numbers, and Currency, Working with Dates, Numbers, and Currencies, Parsing, Tokenizing, and Formatting, Locating Data via Pattern Matching, Tokenizing. Class and

Object, Encapsulation and Abstraction, Inheritance, Polymorphism, Message Passing, Class Syntax, Access Modifiers, class, class Name, extends, implements keywords, Possible, syntaxes of Classes, Procedure to use classes in Java, Internal flow in Class Utilization, More than one class in Single Java Appl, Concrete Methods Vs Abstract Methods. Abstract Classes, Interfaces, Method Syntax.

Module 3 **15 Hours**

User defined Immutable Class, Object and Instance Constructors : Introduction, Default Constructor, User Defined Constructors, Constructor Overloading, Instance Block and Instance Flow Of Execution, 'this' keyword, 'static' keyword, Class.forName() method internal functionality, newInstance() method internal functionality, Utilizations of Class.forName() and newInstance() methods, Factory Methods, Singleton classes, final keyword, 'public static final' Convension for constant variables, enum keyword, main() method, Introduction To Relationships, Association, Composition and Aggregation. Inheritance: Introduction, Types of Inheritance, Static Context in Inheritance, Instance Context in Inheritance, Method Overloading, Rules and Regulations for Method Overriding, Abstract Methods and Abstract classes Introduction, Concrete Method and Abstract Method, Concreate class and Abstract Class, Abstract Class, Interfaces, Syntaxes between classes, abstract classes and Interfaces. Exception - Call Stack Mechanism the try catch block, The Finally Block, Exception Hierarchy, Multiple Exceptions In a Catch Block, Parameterized Try Block, Overriding Methods And Exception. Creating Your Own Exception, The Assert Keyword.

Total Hours	**45**

Laboratory Component:

S. No	List of Experiments
1.	Write a Java program to demonstrate the Methods, Classes and Constructors.
2.	Write a Java program to demonstrate String concepts.
3.	Write a Java program to implement the Inheritance concepts.
4.	Write a Java program to implement the Polymorphism.
5.	Write a Java program to implement the abstract Class and interfaces.
6.	Write a Java program to demonstrate the concept of File handling.
7.	Write a Java program to demonstrate serialization.
8.	Write a Java program to demonstrate the Java Packages.
9.	Write a Java program to implement Exception Handling Mechanism.
Total Hours	**30**

Text Books:

1.	Herbert Schildt, “Java: The Complete Reference”, 11th Edition, Oracle Press, 2021
2.	Paul Deitel, Harvey Deitel, “Java How to Program, Late Objects”,11th Edition, Pearson Education,2018

Reference Books:

1.	Cay S. Horstmann, “Core Java Volume I—Fundamentals”, 11th Edition, Pearson Education, 2020
2.	Y. Daniel Liang ,”Introduction to Java Programming”,9th Edition , Prentice Hall Publications ,2015
3.	Robert W Sebesta, “Programming the World Wide Web”, 7th Edition, Pearson Education Inc., 2014.
4.	Steven Holzner, “Java 2 Black book”, Dreamtech Press, 2011.
5.	Timothy Budd,”Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000
Web References:	
1.	https://docs.oracle.com/javase/tutorial/
2.	https://onlinecourses.nptel.ac.in/noc20_cs58/preview
3.	http://www.javatpoint.com
4.	https://www.geeksforgeeks.org/functional-programming-in-java-with-examples/
Online Resources:	
1.	https://www.coursera.org/learn/object-oriented-java
2.	https://www.coursera.org/specializations/java-object-oriented

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C302.1	Apply	Quiz & Assignment	20
C302.2	Apply	Assignment	20
C302.3	Analyze	Case study	20

C302.4	Apply	Group Assignment	20
C302.5, C302.6	Apply		

Assessment based on Summative and End Semester Examination - Theory			
Bloom's Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1: (60 Marks)	**CIA2: (60 Marks)**	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		**Theory Examination (35%) Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C302.1	3	3	2	2	2				2			2	3	2	2
C302.2	3	3	2	2	2				2			2	3	2	2
C302.3	3	3	2	2	2				2			2	3	2	2
C302.4	3	3	2	2	2				2			2	3	2	2
C302.5	3	3	2	2	2				2			3	3	2	2

21CS303	MANAGING DATA USING RDBMS	3/0/2/4
Nature of Course:	D (Theory Applications)	
Prerequisites:	Nil	

Course Objectives:

1	To describe information and data models and relational databases.
2	To explain an Entity Relationship Diagram and design a relational database for a specific use case.
3	To implement different relational model constraints.
4	To manage database using SQL commands

Course Outcomes:

Upon completion of the course, students shall have ability to:

C303.1	Conceptualize data using the data models.	[U]
C303.2	Improve the database design through normalization.	[U]
C303.3	Manipulate a database using SQL.	[AP]
C303.4	Implement advanced SQL concepts on database.	[AP]
C303.5	Infer the transactions management and storage structures in a database environment.	[A]

Course Contents:

MODULE I Introduction **15 Hours**

Introduction to DBMS, Characteristics of DBMS, DBMS vs File Systems, need for DBMS, Three Level DBMS Architecture, Data Models – Introduction, Benefits, and Phases, ER Diagrams – Symbols, Components, Relationships, Weak entities, Attributes, Cardinality, Relational Algebra, Domain Relational Calculus, Tuple Relational Calculus, Normalization - 1NF, 2NF, 3NF, BCNF, 4NF

MODULE II Constraints and SQL Commands **15 Hours**

DDL Commands - Create, Drop, Alter, Truncate, Rename, Keys - Primary Key, Foreign Key DML Commands - Select, Insert, Update, Delete, Any, All, In, Exists, Non Exists, Union, Intersection, Subqueries - nested, correlated, Joins- Inner, Outer, and Equi, Functions - SUM, COUNT, AVG, MIN, MAX, Clauses - Group By, Having By, Embedded SQL, Dynamic SQL, Transaction Concepts – Transaction model – ACID Properties – Serializability –Transactions as SQL statements.

MODULE III Queries and Transactions **15 Hours**

Creation and Dropping of Views, Creation and Execution of Stored Procedures Cursors and Triggers - Opening, Fetching and Closing, Creation , Insertion, Deletion and Updating Database Applications: Payroll Processing Systems, Railway Reservation Systems, Bank Management System Introduction, Storage media and file structures, B+ Tree Hashing – static and Dynamic, Introduction to Query Processing – Issues in query optimization – Steps in query processing, Concurrency control and transactions, Lock based protocols Recovery System – Failure classification.Concurrency control and transactions, Lock based protocols Recovery System – Failure classification.

Lab Experiments:

1. Conceptual Database design using E-R DIAGRAM
2. Implementation of SQL commands DDL, DML, DCL and TCL
3. Queries to demonstrate implementation of Integrity Constraints
4. Practice of Inbuilt functions
5. Implementation of Join and Nested Queries AND Set operators
6. Implementation of virtual tables using Views
7. Practice of Procedural extensions (Procedure, Function, Cursors, Triggers)
8. Document Database creation using MongoDB
9. Study of Cloud Storage
10. Mini Project (Application Development)

i) IT Training Group Database ii) Blood Donation System iii) Salary Management System iv) Traffic Light Information System	
Total Hours:	**45+30 Hours**
Text Books:	
1	Abraham Silberschatz, Henry F Korth, S Sudarshan, “Data base System Concepts”, 7th edition, McGraw hill, 2020.
2	Vijay Krishna Pallaw, “Database Management Systems”, 2nd Edition Asian Books Private Limited, 2010.
3	Mark L. Gillenson, "Fundamentals of Database Systems", 7th Edition, Wiley India Pvt. Limited, 2008.
Reference Books:	
1	Raghu Ramakrishnan, Johannes Gehrke, Raghu Ramakrishnan, Johannes Gehrke ,"Database Management Systems", McGraw-Hill Education, 2017
2	C. Date, "SQL and Relational Theory", O'Reilly Media, Incorporated,2011.
Web References:	
1	http://www.sqlcourse.com/
2	https://www.w3schools.com/sql/
3	https://www.geeksforgeeks.org/dbms/
Online Resources:	
1	https://www.coursera.org/learn/database-management
2	https://www.udemy.com/database-management-system/
3	https://onlinecourses.swayam2.ac.in/cec22_cs18/preview

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Formative Assessment based on Capstone Model - Theory			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (10%) [80 Marks]**
C303.1	Understand	Quiz & Assignment	20

C303.2	Understand	Assignment	20
C303.3	Apply	Case study	20
C303.4	Apply	Group Assignment	20
C303.5	Analyze		

Assessment based on Summative and End Semester Examination - Theory

Bloom's Level	Summative Assessment (15%) [120 Marks]		End Semester Examination (35%) [100 Marks]
	CIA1: (60 Marks)	CIA2: (60 Marks)	
Remember	10	10	10
Understand	40	40	40
Apply	40	40	40
Analyse	10	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical

Bloom's Level	Continuous Assessment (25%) [100 Marks]		End Semester Examination (15%) [100 Marks]
	FA: (75 Marks)	SA: (25 Marks)	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (50%)								End Semester Examination (50%)
CA 1 (100 Marks)			CA 2 (100 Marks)			Practical Exam (100 Marks)		Theory Examination (35%) Practical Examination (15%)
SA 1 (60M)	FA 1		SA 2 (60M)	FA 2		FA (75M)	SA (25M)	
	Component-I (20 Marks)	Component-II (20 Marks)		Component-I (20 Marks)	Component-II (20 Marks)			

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C303.1	3	1			1					1		1	2		1
C303.2	3	3	3	3					2	2		3	3	2	2
C303.3	3	3	2	1					2	1	2	3	3	2	2
C303.4	3	3	2	2	2				2	1	2	2	3	2	2
C303.5	3	2	2		2				1	2	2	3	2	2	2

21AD401	FUNDAMENTALS OF OPERATING SYSTEMS	3 / 0 / 0 / 3

Nature of Course:	G - Theory analytical
Pre requisites:	Computer Architecture and Digital Logic

Course Objectives:

1	To understand the design principles of Operating System.
2	To describe the mechanisms of OS to handle processes and threads and their communication.
3	To explore the various scheduling approaches and to provide solutions for concurrency, deadlock and starvation.
4	To identify the mechanisms involved in Memory management and its schemes.
5	To analyze the various I/O and File management techniques.
6	To understand the basics of Embedded OS, Computer Security threats and distributed systems

Course Outcomes:
Upon completion of the course, students shall have ability to

C401.1	Identify the basic concepts and design issues of operating systems.	[R]
C401.2	Understand the principles of process and threads.	[U]
C401.3	Illustrate the approaches in scheduling and deadlocks to apply in real world problems.	[AP]
C401.4	Apply concepts of memory management including Virtual Memory to the issues that occur in Real time applications.	[AP]
C401.5	Identify issues related to IO hardware, file system and disk management	[U]

Course Contents:

Module I: Computer System Overview **15 Hours**

Operating System Functions and design issues – The Evolution of Operating Systems – Developments leading to Modern Operating Systems – Virtual Machine – OS design considerations for Multiprocessor and Multicore – Process description and control – Threads.

Module II: Concurrency and Memory **15 Hours**

Mutual Exclusion and Synchronization – Deadlock and Starvation – Uniprocessor Scheduling – Multiprocessor and Real-Time Scheduling – Memory Management requirements – Memory partitioning – Paging – Segmentation – Virtual Memory.

Module III: Input / Output and File Systems **15 Hours**

I/O Devices – Organization of the I/O Function - OS design issues – I/O Buffering – Disk Scheduling – RAID – Dish Cache – File Management Overview – File Organization and Access – B-Trees – File Directories – File Sharing – Record Blocking – Secondary Storage Management - File System Security. **Case Study:** Embedded Operating Systems – Operating System Security – Distributed Processing – Client/Server Computing and Clusters.

Total Hours:	**45**

Text Books:

1.	William Stallings, “Operating Systems – Internals and Design Principles”, 9th Edition, Pearson Publications, 2017.

2.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, 10th Edition, John Wiley, 2018
Reference Books:	
1	Andrew S. Tanenbaum, Modern Operating Systems 5th Edition, Pearson Education, 2016.
2	D.M Dhamdhere, “Operating Systems”- A Concept based Approach, 3rd Edition, McGraw Hill, 2017.
Web References:	
1	http://geeksforgeeks.org/Operating Systems
2	https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/
Online Resources:	
1	https://www.coursera.org/learn/os-power-user
2	https://nptel.ac.in/courses/106108101/
3	https://learn.saylor.org/course/CS401

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C401.1	Remember	Quiz	20
C401.2	Understand	Tutorial	20
C401.3	Apply	Group Assignment	20
C401.4	Apply		
C401.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C401.1	1	1	1									2			2
C401.2	3	3	2									3			2
C401.3	3	3	2									2			3
C401.4	3	3	2									3			3
C401.5	3	3	2									3			2

21AD402	DATA WAREHOUSING AND MINING	3/0/0/3

Nature of Course:	D (Theory application)
Pre requisites:	Nil

Course Objectives:

1	To know the Architecture of a Data Mining system.
2	To be familiar with the Data warehouse architecture and its Implementation.
3	To explore the various Mining techniques
4	To understand the various classification and clustering techniques
5	To analyze the cluster-based Methods.

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Understand the evolutionary path that has led to the purpose of adapting to Data Warehouse and Data Mining techniques in various domains.	[U]
C402.2	Identify the need of Data Warehouse tools and techniques for designing and developing different types of databases.	[AP]
C402.3	Measure the performance of any classification algorithm and Clustering.	[AP]
C402.4	Comprehend the importance and role that Data Warehouse and Data Mining play in various fields.	[U]
C402.5	Apply the knowledge on Clustering Methods and its applications using real time data.	[AP]

Course Contents:

Introduction to Data Warehousing and Data Mining **15 Hours**

Data Warehousing Components –Building a Data warehouse – Data Warehouse Architecture, OLAP vs OLTP, OLAP operations - Data Warehouse v/s Data Mining, Data Mining Process, Data Mining Functionalities, Data Pre-processing – Descriptive Data Summarization, Data Cleaning, Integration and Transformation, Reduction.

Data Mining Concepts: **15 Hours**

Classification, Issues in Classification, Statistical-Based Algorithms, Distance-Based Algorithms, Decision Tree-Based Algorithms, Prediction – Prediction techniques, Linear and Non-Linear Regression. Association Rule Mining: Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis.

Clustering and its real time application: **15Hours**

Categorization of Major Clustering Methods: Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Outlier Detection. Applications of clustering -Pattern recognition, Finding similar users on Twitter, Analyzing the Stack Overflow data set.

Total Hours:45

Text Books:	
1	ReemaThareja, “Data Warehousing”, Oxford University Press.
2	Jiawei Han, MichelineKamber and Jian Pei, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.
3	Alex Berson and Stephen J. Smith “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, Tenth Reprint 2007.
Reference Books:	
1	W.H. Inmon, “Building the Data Warehouse”, John Wiley & Sons, Inc, 4th Edition, 2005
2	VikramPudi, P. RadhaKrishana “Data Mining”, Oxford University press
3	K.P. Soman, ShyamDiwakar and V. Ajay “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2006.
Web References:	
1	https://examupdates.in/data-mining-lecture-notes/
2	http://www.miet.edu/course/wp-content/uploads/2019/05/dwdm-completed-notes.compressed.pdf
3	https://livebook.manning.com/book/mahout-in-action/chapter-12/82
Online Resources:	
1	https://www.classcentral.com/subject/data-mining
2	https://onlinecourses.nptel.ac.in/noc20_cs12/preview
3	https://www.coursera.org/specializations/data-mining

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C402.1	Understand	Quiz	20
C402.2	Apply	Tutorial	20
C402.3	Apply	Group Assignment	20
C402.4	Understand		

C402.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C402.1	1	2	1									2	2	2	1
C402.2	3	3	2									3	2	3	2
C402.3	3	3	2									2	3	3	3
C402.4	3	3	2									3	3	2	3
C402.5	2	3	3									2	3	2	3

21MA404	RANDOM VARIABLES AND STATISTICS	3 / 1 / 0 / 4
Nature of Course	B (100% analytical)	
Pre requisites	-	

Course Objectives:

1	To study the basic probability concepts
2	To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena
3	To acquire skills in handling situations involving more than one random variable
4	To learn the concept of testing hypothesis using statistical analysis
5	To apply the Analysis of variance classifications in one way and two way

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Recall the concepts of basic probability.	[R]
C404.2	Understand how to handle situations involving random variable.	[U]
C404.3	Applying different pattern of standard distributions in real life problems.	[AP]
C404.4	Use distribution in cluster analysis of similar binary variables.	[AP]
C404.5	Derivethe logic and attain the knowledge of hypothesis testing.	[AP]
C404.6	Apply the analytical comparisons using ANOVA.	[AP]

Course Contents:

MODULE I - PROBABILITY AND RANDOM VARIABLES **20 Hrs**

Probability: Probability concepts - Addition and Multiplication law of probability – Conditional probability - Total probability theorem - Bayes theorem– **Random Variables:** One dimensional random variable - Discrete random variables -Probability mass function - Continuous random variables - Probability density function- Moments and Moment generating Function.

MODULE II - STANDARD DISTRIBUTIONS **20 Hrs**

Discrete distributions - Binomial – Poisson – Geometric – Continuous distributions - Uniform – Exponential - Normal distributions –Weibull distribution. **Two dimensional random variables**: Joint distributions - Marginal and conditional distributions – Covariance – Correlation and rank correlation - Regression and their properties.

Module 3: Statistics **20 hrs**

Mean, median, mode and standard deviation for raw, discrete and continuous data - Testing of Hypothesis: Large sample - Z test -Test of significance - Proportions - Small sample test – t test and F test for single mean – difference of means and variance - Chi-square test for goodness of fit and independence of attributes. **Analysis of variance**: One way and two way classifications. Latin square method.	
Total Hours: 60 Hours	
Text Books:	
1	Gupta, S.C., &Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & sons, 2000,Reprint 2014.
2	Peebles Jr. P.Z., —Probability Random Variables and Random Signal Principles,Tata McGraw-Hill Pubishers, Fourth Edition, New Delhi, 2016(Chapters 6, 7 and 8).
3	Palaniammal, S., —Probability and Random Processes, Prentice hall of India, New Delhi, 2014.
Reference Books:	
1	Ross, S., —A First Course in Probability, Ninth edition, Pearson Education, Delhi, 2014.
2	Henry Stark and John W. Woods —Probability and Random Processes with Applications to Signal Processing, Third Edition, 2001.
3	Richard A. Johnson**,** Irwin Miller**,** John Freund,"Miller & Freund's Probability and Statistics for Engineers", Ninth edition,2016.
4	R for Everyone: Advanced Analytics and Graphics, Jared P. Lander.
5	Hands-on Programming with R, Garrett Grolemund.
Web References:	
1	http://nptel.ac.in/courses/111104079/
2	http://nptel.ac.in/video.php/subjectId=117105085
3	http://nptel.ac.in/syllabus/111105041/
4	http://freevideolectures.com/Course/3028/Econometric-Modelling/22#
5	http://nptel.ac.in/courses/111104079/
Online Resources:	
1	www.edx.org/Probability
2	https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3	https://onlinecourses.nptel.ac.in/noc15_ec07/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C404.1	Remember	Quiz	20
C404.2	Understand	Seminar	20
C404.3 – C404.4	Apply	Tutorial	20
C404.5 – C404.6	Apply	Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	50	50	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Articulation Matrix (Theory)															
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**
1	1	1	-	-	-	-	-	-	-	-	-	-	1	-	-
2	2	2	-	-	-	-	-	-	-	-	-	-	1	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-		-	-
4	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-		-	-
6	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
Avg	**2.5**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0.6**	**-**	**-**
1	Reasonably agreed				2	Moderately agreed					3	Strongly agreed			

21AD403	CLOUD COMPUTING	3/0/0/3

Nature of Course	F (Theory Programming)

Course Objectives:

1	To understand the evolution of AWS from the existing technologies.
2	To have knowledge on AWS security and various scaling methods.
3	To team the necessary skills for design, develop and deploy services in creating with the help of docker.
4	To implement automated system update and DevOps lifecycle
5	To understand virtualization and provide the perfect security for the entire infrastructure.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C403.1	Demonstrate the basic global infrastructure of the AWS Cloud.	[AP]
C403.2	Identify an appropriate solution using AWS Cloud services for various use cases.	[U]
C403.3	Interpret how the components of Docker containers support compute container implementations.	[AP]
C403.4	Examine common Infrastructure Servers, Availability and Scalability.	[A]
C403.5	Learn why automation, culture, and metrics are essential to a successful DevOps project.	[U]

Course Contents:

MODULE I: MANAGING CLOUD USING AWS **15 Hours**

Introduction, Future of AWS, Services - AWS EC2, AWS S3 - Cloud storage, Types, Benefits, AWS IAM - AWS Security, Working of IAM, Components AWS CloudFront Working, Benefits. Introduction, Snapshots vs AMI, Different scaling plans. Introduction, Benefits, Algorithms used for load balancing.

MODULE II: CONTAINERIZATION USING DOCKERS **15 Hours**

Docker, Containers, Usage of containers, Terminology, Docker Run Static sites, Docker Images, Docker File, Docker on AWS, Docker Network, Docker Compose, Development Workflow, AWS EC Services.

MODULE III: DEVOPS **15 Hours**

Introduction, Test Driven Development, Continuous Integration, Code coverage, Best Practices, Virtual Machines vs Containers, Rolling Deployments, Continuous Deployment, Auto Scaling. **Case Study:** Open Stack, Cloud based ML Solutions in Healthcare

Total Hours:	**45**

Text Books:

1	Mark Wilkins, “Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud”, 2019.
2	“Docker: Up & Running: Shipping Reliable Containers in Production”, Sean P. Kane, Karl Matthias, O’Reilly Media Inc, 2015.
3	Jennifer Davis and Ryn Daniels, “Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale”, 2016, O’Reilly Media Inc.

Reference Books:

1	Ardian, “Using Docker: Developing and Deploying Software with Containers”, O’Reilly Media Inc, 2015.

Web References:

1	https://cloudacademy.com/course/introduction-to-devops/intro-3/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	tTotal	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C403.1	Apply	Quiz	20
C403.2	Understand	Tutorial	20
C403.3	Apply	Group Assignment	20
C403.4	Analyze		
C403.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C403.1	2	1	3	3	3	2					2	3	2	3	3
C403.2	1	2	3	3	3	2					2	3	2	3	3
C403.3	2	2	3	3	2	2					2	3	2	3	3
C403.4	2	1	3	3	3	2					2	3	2	3	3
C403.5	2	1	2	3	2	2					2	3	2	3	3

21IT402	SOFTWARE TESTING USING SELENIUM	3/0/0/3
Nature of Course	F (Theory Programming)	
Pre requisites	Nil	
Course Objectives:		
1.	To provide students with an understanding of Core Testing concept.	
2.	To learn the functional and non-functional testing.	
3.	To understand the different types of User Acceptance testing and end-to-end testing.	
4.	To get familiarize with the best practices of Testing.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C402.1	Plan and apply the appropriate level of testing within the context of a software development application to the satisfaction of its beneficiaries.	[AP]
C402.2	Analyze specific and measurable test cases to ensure coverage and traceability to requirements	[A]
C402.3	Understand the problem of reporting techniques, metrics, and testing status reports and communicate testing results to colleagues, managers, and end users.	[U]
C402.4	Apply testing models, processes and practices appropriate for the software development lifecycle model of a project	[AP]
C402.5	Apply principles and practices of test-driven development to improve testing quality and reduce delivery times	[AP]
C402.6	Inspect the various testing processes towards the continuous delivery of a software product.	[A]

Course Contents:

Introduction to Automation Testing with Selenium: **15 Hours**

Introduction to Automation Testing, Advantages and Disadvantages History of selenium, why selenium, Difference between selenium and other tools, Components, Variables and Datatypes, Control Statements, Arrays, Strings and Functions, Classes and Objects, Inheritance, and Polymorphism, Exception Handling, Collections, and File Handling.

Working with Selenium: **15 Hours**

Introduction, generating scripts, wait commands, Validation commands, Store commands, Limitations, Sample Program, Navigation, radio Buttons and Checkbox, drop down list, File upload, drag and drop. Error and alert messages, multiple windows, Iframes, web table and calendar, Types and use of framework, Execution of programs, checking reports, Implementing Listeners, run group test cases.

Maven: **15 Hours**

Maven configuration, Executing TestNG from maven, managing Test suites, Read and write excel, Creating and Building test cases, build validation and generic functions, Reports Run project with ANT/MAVEN/Eclipse, JDBC Drivers, Connection Interface, Prepared Statement, Resulset and basic commands, Reading nodes and hubs, Types of browsers, Limitations and Configurations. Running tests on browsers, prioritizing the test cases, node timeout, Grid coding, Scenario building and execution.

Total Hours	**45**

Text Books:

1.	Rex Allen Jones II, “Absolute Beginner, Part 1 Selenium Webdriver for Functional Automation Testing”, 1st Edition, Createspace Independent Pub, 2016.
2.	S Basu, “Selenium with Python Simplified for Beginners”, 1st Edition, 2020.
3.	Paul Watson, “Selenium webdriver with Node.js: Beginner's Guide”, 1st Edition, CreateSpace Independent Publishing Platform, 2016.
Reference Books:	
1.	Satya Avasarala, “Selenium Web Driver Practical Guide”, 1st Edition, Packt Publishing Limited, 2014.
2.	Sujay Raghavendra, "Python Testing with Selenium: Learn to Implement Different Testing Techniques Using the Selenium WebDriver", Apress, 2020.
3.	Pinakin Ashok Chaubal, “Selenium Framework Design in Keyword-Driven Testing: Automate Your Test Using Selenium”, BPB Publications, 2020.
Web References:	
1.	https://www.coursera.org/projects/building-test-automation-framework-using-selenium-and-testng
2.	https://www.edx.org/professional-certificate/delftx-automated-software-testing
3.	https://onlinecourses.nptel.ac.in/noc22_cs12/preview
4.	https://www.nextgenerationautomation.com/post/selenium-coding-exercises
5.	https://www.studytonight.com/maven/build-and-test-maven-project
Online Resources:	
1.	https://www.tutorialspoint.com/selenium-for-software-testing-getting-started/index.asp
2.	https://www.softwaretestingmaterial.com/selenium-tutorial/
3.	https://www.leapwork.com/discover/selenium-automation

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**tTotal**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C402.3	Understand	Assignment	20
C402.5	Apply	Quiz	20
C402.1 C402.4	Apply	Case Study	20

C402.2, C402.6	Analyse	Group Assignment	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	-	10
Understand	20	20	20
Apply	60	50	40
Analyse	10	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C402.1	2	2	2	2	2						2	2	2	2	2
C402.2	2	2		1	2						2	2	2	2	2
C402.3	2		1	1	3						2	2	2	2	2
C402.4	2	2	1	2	1						3	3	2	3	2
C402.5	1	2	2	1	2						2	3	3	2	2
C402.6	1	3	2	1	2						2	2	2	3	2

21CS402	WEB FRAMEWORKS	3/0/0/3
Nature of Course:	D (Theory Application)	
Pre requisites:	Java Programming	

Course Objectives:

1	To impart the knowledge of REST API and HTTP methods used in Spring Boot Framework.
2	To discuss LIKE queries using JPA and handle CRUD operations with JPQL.
3	To explore the various relational mapping with JPA.
4	To deploy Spring AOP - Annotation Based applications.

Course Outcomes:
Upon completion of the course, students shall have ability to:

C402.1	Create simple applications with REST API and handle HTTP methods.	[AP]
C402.2	Apply LIKE queries using JPA.	[AP]
C402.3	Build application using Spring Boot and handle CRUD operations with JPQL.	[AP]
C402.4	Demonstrate various relational mapping with JPA.	[U]
C402.5	Develop Spring AOP - Annotation Based Application	[AP]

Course Contents:

Module I : APIs and JSON **15 Hours**

REST API, HTTP Methods in Rest, Overview of JSON, Controller and Service Layer, GET API with JSON & Spring Boot, @Value annotation, Runnable JAR Of Spring Boot App, @JsonIgnore Usage, @JsonProperty Usage, MySQL Database.

Module II : Spring JPA **15 Hours**

Spring Boot-MySQL Database Connection with JPA, @Repository Annotation, GET API with JPA, HTTP POST API, PUT API, DELETE API with @RequestParam, Path variable - @PathVariable, AND,OR,IN Query using JPA, Pagination & Sorting using JPA. @Transient Annotation, Queries using JPA, Starts and Ends with query using JPA, JPQL with @Query Annotation, Select, Update, Delete with JPQL.

Module III: JPA Mapping with Spring Boot **15 Hours**

OneToOne Relationship Mapping with JPA, Join Query, Lazy Loading in JPA, BiDirectionalOneToOne Relationship with JPA, OneToMany Relationship with JPA, Insert Record with OneToOne and OneToMany Relationship and JPA. SwaggerUI with Spring Boot, OpenUI with Spring Boot, Logging with Spring Boot, Changing Log Level,Logging Request and Response JSON, Logging properties with Spring Boot. AOP Terms, @BeforeAdvice with Method Parameter,@After Advice,@AfterReturning Advice, @Around Advice.

Total Hours: 45

Text Books:

1.KirupaChinnathambi, “A Hands-On Guide to Building Web Applications Using React and Redux”, Addison-Wesley Professional, 2018.

2.Raja CSP Raman, LudovicDewailly, “Building RESTful Web Services with Spring 5”, Packt Publishing, 2018.

3.Leonard Richardson, Sam Ruby “RESTful Web Services” O'Reilly Media, 2008.

Reference Books:

1.Ranga Karanam, “Master Java Web Services and REST API with Spring Boot”, Packt Publishing, 2018.

2.Balaji Varanasi, Sudha Belida, “Spring REST”, Apress, 2015.

Web References:

1.https://www.freecodecamp.org/news/how-to-build-a-rest-api-with-spring-boot-using-mysql-and-jpa-f931e348734b/
2.https://github.com/scbushan05/book-api-spring-boot
3.https://www.geeksforgeeks.org/spring-value-annotation-with-example/
4.https://www.baeldung.com/spring-jpa-like-queries
5.https://medium.com/thecodefountain/design-a-rest-api-with-spring-boot-and-mysql-a5572d94ccc7
Online Resources:
1.https://www.udemy.com/course/rest-api-with-java-spring-boot-spring-data-jpa-jparepository-swagger/
2.https://spring.io/guides/tutorials/rest/
3.https://www.javaguides.net/2018/10/spring-boot-2-restful-api-documentation-with-swagger2-tutorial.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C402.1,C402.2 & C402.3	Apply	Mini Project	**40**
C402.4	Understand	Quiz	**20**
C402.5	Apply	Case Study	**20**

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	10	10	10
Understand	20	20	20
Apply	70	70	70
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

														Programme Specific Outcomes (PSO)	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C402.1	2	2	2									1	2		1
C402.2	3	3	3	2	2				2	1		3	3	1	2
C402.3	3	3	3	3	3				2	1		3	3	2	2
C402.4	3	3	3	3	3				2	1		3	3	2	2
C402.5	3	3	3						1	1		3	3		1
C402	**3**	**3**	**3**	**3**	**3**				**2**	**1**		**3**	**3**	**2**	**2**

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

21AD404	CLOUD COMPUTING LABORATORY	0 / 0 / 3 / 1.5
Nature of Course	M (Practical Application)	
Pre requisites	Data Base Design	

Course Objectives:

1	To understand the evolution of AWS from the existing technologies.
2	To have knowledge on AWS security and various scaling methods.
3	To team the necessary skills for design, develop and deploy services in creating with the help of docker.
4	To implement automated system update and DevOps lifecycle.
5	To understand virtualization and provide the perfect security for the entire infrastructure.

Course Outcomes:
Upon completion of the course, students shall have ability to

C404.1	Demonstrate the basic global infrastructure of the AWS Cloud.	[AP]
C404.2	Identify an appropriate solution using AWS Cloud services for various use cases.	[U]
C404.3	Interpret how the components of Docker containers support compute container implementation.	[AP]
C404.4	Examine common Infrastructure Servers, Availability and Scalability.	[A]
C404.5	Learn why automation, culture, and metrics are essential to a successful DevOps project.	[U]

List of Experiments:

1. Study of Hosted Hypervisor and Bare Metal Hypervisor.
2. Install a Virtualbox / VMware Workstation with different flavours of linux or windows S.
3. Implementation of Virtual Machine(S) and create a Virtual Datacenter.
4. Configuration of Virtual Internetworking Components.
5. Deployment of VMs in AWS.
6. Install a docker engine and docker client on windows.
7. Creation and removal of container, container images.
8. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
9. Find a procedure to transfer the files from one virtual machine to another virtual machine Using VMWare.
10. Install Google App Engine. Create a hello world app and other simple web applications using python / java.

Total Hours:	**30**

Text Books:

1	Mark Wilkins, “Learning Amazon Web Services (AWS): A Hands-On Guide to the Fundamentals of AWS Cloud”, 2019.
2	“Docker: Up & Running: Shipping Reliable Containers in Production”, Sean P. Kane, Karl Matthias, O’Reilly Media Inc, 2015.
3	Jennifer Davis and Ryn Daniels, “Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale”, 2016, O’Reilly Media Inc.

Reference Books:	
1.	Ardian, “Using Docker: Developing and Deploying Software with Containers”, O’Reilly Media Inc, 2015.
Web References:	
1	https://cloudacademy.com/course/introduction-to-devops/intro-3/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom’s Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	30	30	30
Evaluate	10	10	10
Create	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C404.1	3	3	3					3	3	3		3			3
C404.2	3	3	3					3	2	3		3			3
C404.3	3	3	3					3	3	3		3			3
C404.4	3	3	3					3	3	3		3			3
C404.5	2	3	3					2	3	2		3			2

21CS403	WEB FRAMEWORKS LABORATORY	0/0/3/1.5
Nature of Course:	**L (Programming)**	
Pre requisites:	Java Programming	

Course Objectives:

1	To impart the knowledge of REST API and HTTP methods used in Spring Boot Framework.
2	To implement LIKE queries using JPA and handle CRUD operations with JPQL.
3	To develop the various relational mapping with JPA Repository.
4	To deploy Spring Rest controller API.

Course Outcomes:
Upon completion of the course, students shall have ability to

C403.1	Create simple applications with REST API and handle HTTP methods.	[AP]
C403.2	Create a simple Spring Application and inject the literal values by setter injection methods.	[AP]
C403.3	Apply LIKE queries using JPA to Various applications.	[AP]
C403.4	Build application using Spring Boot with JPA repository.	[A]
C403.5	Create applications with Spring Rest Controller API to perform CRUD operations.	[C]

Laboratory Experiments:

1. Display the information about the current weather in a certain location using RESTful API use a weather forecast provider such as openweathermap.org.
2. Create your own app that embeds the information about flights, hotels and rental cars using Skyscanner API.
3. Create a simple Spring Application and inject the literal values by setter injection. So, create a simple class Employee having three attributes Id, Name, and Designation. Create setter methods for these attributes and a simple method to print the details of the student.
4. Create a simple payroll service that manages the employees of a company. Store employee objects in a database, and access them (via something called JPA).
5. Create a simple payroll service that manages the employees of a company. Perform the following LIKE queries using query methods with the keywords Containing, Contains, IsContaining, StartsWith and EndsWith.
6. Create a simple payroll service that manages the employees of a company. Perform the following LIKE queries using query methods with the keywords NotContains, NotContaining and NotLike.
7. Create a Spring Boot application with Student entity and Student JPA repository. Use Spring Rest Controller API to perform CRUD operations on Student data.
8. Build a simple Rest API application called Donors. This application manages blood donors information and allows its users to Add a new donor, update existing donor information, view existing donors and delete a donor information from the application.

Total Hours: 30

Text Books:

1.KirupaChinnathambi, “A Hands-On Guide to Building Web Applications Using React and Redux”, Addison-Wesley Professional, 2018.

2.Raja CSP Raman, LudovicDewailly, “Building RESTful Web Services with Spring 5”, Packt Publishing, 2018.

3.Leonard Richardson, Sam Ruby “RESTful Web Services” O'Reilly Media, 2008.

Reference Books:

1.Ranga Karanam, “Master Java Web Services and REST API with Spring Boot”, Packt Publishing, 2018.
2.Balaji Varanasi, Sudha Belida, “Spring REST”, Apress, 2015.
Web References:
1.https://www.freecodecamp.org/news/how-to-build-a-rest-api-with-spring-boot-using-mysql-and-jpa-f931e348734b/
2.https://github.com/scbushan05/book-api-spring-boot
3.https://www.geeksforgeeks.org/spring-value-annotation-with-example/
4.https://www.baeldung.com/spring-jpa-like-queries
5.https://medium.com/thecodefountain/design-a-rest-api-with-spring-boot-and-mysql-a5572d94ccc7
Online Resources:
1.https://www.udemy.com/course/rest-api-with-java-spring-boot-spring-data-jpa-jparepository-swagger/
2.https://spring.io/guides/tutorials/rest/
3.https://www.javaguides.net/2018/10/spring-boot-2-restful-api-documentation-with-swagger2-tutorial.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	-	-	-
Understand	-	-	-
Apply	50	60	60
Analyse	30	40	40
Evaluate	10	-	-
Create	10	-	-

Course Outcome	**Program Outcome (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C402.1	2	2	2			3						1	2		1
C402.2	3	3	3	2	2	2			2	1		3	3	1	2

C402.3	3	3	3	3	3	3			2	1		3	3	2	2
C402.4	3	3	3	3	3	3			2	1		3	3	2	2
C402.5	3	3	3			3			1	1		3	3		1
C402	**3**	**3**	**3**	**3**	**3**	**3**			**2**	**1**		**3**	**3**	**2**	**2**

	3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed	

21AD501	FUNDAMENTALS OF SIGNALS AND SYSTEMS	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre requisites	DICRETE TRANSFORMS AND FOURIER ANALYSIS	
Course Objectives:		
1	Understand the basic properties of signals and systems.	
2	Understanding signals and systems in terms of both time and frequency domains.	
3	Utilize the Laplace transform method to solve continuous, linear, time-invariant systems and to obtain transfer functions.	
4	Developing Expertise in time domain and frequency domain approaches to the analysis of Discrete time signals and system in Fourier and Z-transform domain.	
5	Development of the mathematical skills to solve problems involving convolution and filtering.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C501.1	Acquire the knowledge of signal, system and its classifications.	[R]
C501.2	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier and Laplace	[AN]
C501.3	Explore their acquired knowledge on recalling the applications of transformation techniques	[AP]
C501.4	Analyze the response of LTI system using convolution integral and LSI system using convolution.	[AN]
C501.5	Apply Fourier transform and Z-transform for the analysis of discrete-time signals and systems.	[AP]

Course Contents:

MODULE I CLASSIFICATION OF SIGNALS AND SYSTEMS **15 Hours**

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Classification of signals — Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals — Classification of systems- CT systems and DT systems- — Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

MODULE II ANALYSIS OF CONTINUOUS TIME SIGNALS **15 Hours**

Fourier Transform — properties- Laplace Transforms and properties - system representation using differential equations – System Analysis using Laplace transform and Fourier transform -–Impulse response and step response –Convolution integral.

MODULE III ANALYSIS OF DISCRETE TIME SIGNALS **15 Hours**

Discrete Time Fourier Transform (DTFT) and its properties – System representation using difference equations – Relationship between Z-transform and DTFT- System Analysis using Z-transform and DTFT – stability – impulse response and step response – convolution sum.

Total Hours:	**45**

Text Books:	
1	Allan V. Oppenheim et al," Signals and Systems", Prentice Hall of India, 2/E, 2015
2	Ramakrishna Rao P, "Signals and Systems", McGraw Hill Education, New Delhi, 2/E, 2013.
Reference Books:	
1	J. Roberts, "Fundamentals of Signals and Systems", Tata McGraw Hill, 2007.
2	B. P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, 1998.
3	R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems – Continuous and Discrete", Prentice Hall, 4/E, 1998.
Web References:	
1	http://www.nptelvideos.in/2012/12/signals-and-system.html

2	http://freevideolectures.com/Course/3177/Signals-and-Systems
Online Resources:	
1	https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-2
2	https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-2

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C501.1	Remember	Quiz	20
C501.2	Analyze	Tutorial	20
C501.3	Apply	Group Assignment	20
C501.4	Analyze		
C501.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II**	

					(20 Marks)	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C501.1	2	2	3	3	1		1				1	2	2	1	2
C501.2	3	3	3	3	1		1				1	2	2	1	2
C501.3	3	3	3	3	1		1				1	2	2	1	2
C501.4	3	3	3	3	1		1				1	2	2	1	3
C501.5	3	3	3	3	1		1				1	3	2	1	2

21AD502	MACHINE LEARNING	3/0/0/3
Nature of Course	: G (Theory Analytical)	
Pre requisites	: Probability & Statistics	

Course Objectives:

1.	To introduce applications of machine learning and case studies.
2.	To provide an insight to different supervised learning techniques, merits and demerits.
3.	To enable the students to understand Graphical models and their applicability to real world problems.
4.	To explore discovering clusters in the given data.
5.	To study and evaluate dimensionality reduction for the given data.

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Understanding the fundamental issues and challenges of machine learning.	[U]
C502.2	Explore the acquired knowledge on recalling the applications of machine learning.	[AP]
C502.3	Understand the concepts behind different types of learning and their appropriateness.	[U]
C502.4	Analyze the observations for a given set of data.	[AN]
C502.5	Choose and apply appropriate learning technique for a given real world problem.	[AP]

Course Contents:

Introduction to Machine Learning: **(15 Hrs)**

Introduction – Data Preprocessing - Designing a learning system, Issues. Examples of Machine Learning Applications, Overview: Supervised Learning, Learning Associations, Classification, Regression, Unsupervised learning and Reinforcement Learning.

Supervised Learning: **(15 Hrs)**

Generative vs discriminative learning, Decision Tree learning, Neural Networks, Support vector machines, Instance based learning, Ensemble learning. Linear regression, Logistic regression, Other types of Regression. Case Study: Spam Filtering.

Unsupervised Learning: **(15 Hrs)**

Introduction to Unsupervised learning: Gaussian mixture models, Discovering clusters, Discovering latent factors, Dimensionality reduction – Principal Component Analysis. Case Study: You tube video Recommendation.

Total Hours: 45

Text Books:

1.	Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, 3rd Edition, MIT Press, 2018.
2.	Kevin P. Murphy, “Machine Learning A probabilistic Perspective”, MIT press, 2018.

3.	Tom M. Mitchell , " Machine Learning", 3rd Edition, Tata McGrawHill, 2015.
Reference Books:	
1.	Christopher Bishop," Pattern Recognition and Machine Learning", Springer, 2006.
2.	Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014.
3.	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
Web References:	
1.	https://onlinecourses.nptel.ac.in/noc16_cs18/
2.	http://freevideolectures.com/Course/2257/Machine-Learning
3.	https://www.youtube.com/watch?v=8I6RPr17xac

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C502.1	Understand	Quiz	20
C502.2	Apply	Tutorial	20
C502.3	Understand	Group Assignment	20
C502.4	Analyze		
C502.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

	Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)														
COs	POs												PSOs		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
C502.1	2	3	3	3	2							1	2	3	
C502.2	2	3	3	3	2							1	2	3	
C502.3	3	3	2	3	2							1	3	2	3
C502.4	2	3	2	3	2							1	3	2	
C502.5	2	3	3	2	3							1	3	2	3
	3	Strongly agreed		2	Moderately agreed			1	Weakly agreed						

21AD503	DATA SCIENCE USING R	3/0/3/4.5

Nature of Course	F (Theory Programming)
Prerequisites	Python for Data Science

Course Objectives:

1	Apply quantitative modelling and data analysis techniques to the solution of real-world business problems.
2	To exercise the fundamentals of statistical analysis in the R environment.
3	To analyse data for the purpose of exploration using Descriptive and Inferential Statistics.
4	To use descriptive, predictive and prescriptive analytics to drive growth.
5	To extract valuable information for use in strategic decision making, product development, trend analysis, and forecasting.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C503.1	Understand the different data types in R.	[U]
C503.2	Apply functions in R to perform data analytics.	[AP]
C503.3	Resize data from long to wide and back to support different analysis.	[AP]
C503.4	Identify and deal with missing data.	[A]
C503.5	Understand how to link data, statistical methods, and actionable questions.	[U]

Course Contents:

MODULE I: INTRODUCTION TO R **15 Hours**

Overview of R Language - Data Types - Variable - Operators - Decision Making - Loop control - Array - String - Function - Vector - Lists - Matrices - Factors - Data Frames – Merging Data Frames - Packages - Data and File Management - Charts & Graphs.

MODULE II: DATA ANALYSIS AND VISUALIZATION **15 Hours**

Introduction to data science - Data visualization - A grammar for graphics - Data Pre-processing - Data wrangling on one table - Data wrangling on multiple tables - Tidy data – Iteration – Outlier Detection.

MODULE III: STATISTICS AND MODELING **15 Hours**

Statistical foundations - Predictive modelling – Logistic Regression – Random Forest – Naïve Bayes – Hierarchical Clustering. **Case study:** Fit a series of supervised learning models to predict arrival delays for flights from New York to SFO using the nycflights13 package.

Total Hours: 45 Hours

Lab Experiments:

1. Getting Used to R: Describing Data
2. Creating and displaying Data.
3. Creating and manipulating a List and an Array
4. Creating a Data Frame and Matrix-like Operations on a Data Frame
5. String Manipulations
6. Data transpose operations in R
7. Probability Distributions.
8. Basic Statistics in R
9. Visualizing Data - Tables, charts and plots
10. Creating models for prediction

Total Hours: 30 Hours

Text Books:

1	Benjamin S. Baumer, Daniel T. Kaplan, and Nicholas J. Horton, “Modern Data Science with R” 2nd edition, CRC Press, July 28, 2021.
2	Hadley Wickham & Garrett Grolemund "R for Data Science - Import, Tidy, Transform, Visualize, and Model Data", O'Reilly , 1st edition, December 2016.
3	Tilman M. Davies, "The Book of R", No Starch Press, 1st edition, July 16 2016.
Reference Books:	
1	Joel Grus, "Data Science from Scratch", O'Reilly, 1st edition, April 2015.
2	Norman Matloff, "The Art of R Programming", No Starch Press, 1st edition, 2011.
3	Garrett Grolemund, "Hands on programming with R", O'Reilly , 1st edition, July 22 2014.
Web References:	
1	https://nptel.ac.in/courses/106/106/106106179/
2	https://www.atnyla.com/syllabus/r-programming-language/7

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C503.1	Understand	Quiz	20
C503.2	Apply	Tutorial	20
C503.3	Apply	Group Assignment	20
C503.4	Analyze		
C503.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (15%) [120 Marks]**		**End Semester Examination (35%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20

Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (25%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination								
Continuous Assessment (50%)								**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**		**Theory Examination (50%) Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)**	**SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**			

	Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)														
COs	**POs**												**PSOs**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
C503.1	2	3	3	3	2							1	2	3	
C503.2	2	3	3	3	2							1	2	3	
C503.3	3	3	2	3	2							1	3	2	3
C503.4	2	3	2	3	2							1	3	2	
C503.5	2	3	3	2	3							1	3	2	3
	3	Strongly agreed		2	Moderately agreed			1	Weakly agreed						

21AD504	MACHINE LEARNING LABORATORY 0/0/3/1.5	
Nature of Course	: L (Programming)	
Pre requisites	: Probability & Statistics	
Course Objectives:		
1.	To understand the basic concepts and techniques of Machine Learning through python programming.	
2.	To enable the students to understand Graphical models and their applicability to real world problems.	
3.	To develop skills of using recent machine learning packages for solving practical problems.	
4.	To explore discovering clusters in the given data.	
5.	To study and evaluate dimensionality reduction for the given data.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C504.1	Explore the experience of doing independent study and research.	[AP]
C504.2	Explore the acquired knowledge on recalling the applications of machine learning.	[AP]
C504.3	Design and implement classifiers for machine learning applications.	[AP]
C504.4	Analyze the observations for a given set of data.	[AN]
C504.5	Choose and apply appropriate learning technique for a given real world problem.	[AP]

Course Contents:

1. Implementation of Gaussian Mixture Models
2. Implementation of Data Pre - Processing
3. Implementation of Decision Tree Classifier
4. Implementation of Neural Networks Algorithm
5. Implementation of Support Vector Machines
6. Implementation of K- nearest Neighbor Classifier
7. Implementation of Regression Algorithm
8. Implementation of Clustering Algorithm
9. Implementation of Dimensionality Reduction Algorithm
10. Mini Project

Total Hours : 45

Text Books:

1.	Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, 3rd Edition, MIT Press, 2014.
2.	Kevin P. Murphy, “Machine Learning A probabilistic Perspective”, MIT press, 2012.
3.	Tom M. Mitchell , “ Machine Learning”, 3rd Edition, Tata McGrawHill, 2015.

Reference Books:	
1.	Christopher Bishop," Pattern Recognition and Machine Learning", Springer, 2006.
2.	Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", 1st Edition, Wiley, 2014.
3.	Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
Web References:	
1.	https://onlinecourses.nptel.ac.in/noc16_cs18/
2.	http://freevideolectures.com/Course/2257/Machine-Learning
3.	https://www.youtube.com/watch?v=8I6RPr17xac

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	30	30	30
Evaluate	10	10	10
Create	-	-	-

	Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)														
COs	POs												PSOs		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
C504.1	2	3	3	3	2							1	2	3	
C504.2	2	3	3	3	2							1	2	3	
C504.3	3	3	2	3	2							1	3	2	3
C504.4	2	3	2	3	2							1	3	2	
C504.5	2	3	3	2	3							1	3	2	3
	3 Strongly agreed				2 Moderately agreed							1 Weakly agreed			

21AD601	DATA VISUALIZATION USING TABLEAU	3/0/0/3
Nature of Course	G (Theory Analytical)	
Pre requisites	Nil	
Course Objectives:		
1.	To perceive in-depth knowledge on how to represent data with visual analytics as suits the target audience, task and data.	
2.	To equip the students with knowledge of visual encoding design choices for arranging and representing data in an interactive and spatial form.	
3.	To gain an insight into Data Visualization techniques and tools.	
4.	To explore business insights and achieve business goals in the right direction	
5.	To provide insight and training on designing visualization dashboard that would support decision making on large scale data	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C601.1	To understand the need for data abstraction and task abstraction and would be able to relate with the various data, datasets associated with different applications.	[U]
C601.2	Apply the various visual analytics techniques available for arranging the different types of data.	[A]
C601.3	Identify and apply appropriate data visualization techniques, given particular requirements imposed by the data.	[AP]
C601.4	Employ best practices in data visualization to develop charts, maps, tables and other visual representations of data and would be able to identify the need for reducing and aggregating item-sets.	[R]
C601.5	Apply the different exploratory data analysis techniques on the datasets using Tableau.	[AP]
C601.6	Create Visualizations and dashboards on Tableau.	[AP]

Course Contents:

INTRODUCTION: **15 Hours**

Purpose of visualization, Data Abstraction: Data Types, Dataset types, Attribute types, Semantics, Preparing your Data, Survey Data, Compute descriptive Statistics, Explore the data visually, Design Standards: Chart Format, Color, Text and Labels Readability, Scales, data Integrity, chart Junk, data density, data richness, Attribution and Design Standard Checklist. Task Abstraction: Actions, Targets, Analyzing & Deriving – Example, Four levels for Validation, Marks and Channels, Analysis – Four levels of Validation.

Data Manipulation with Pandas: **15 Hours**

Introduction, Data Indexing and selection, operating on data, handling missing data, Hierarchical Indexing, combining dataset, Aggregation and Grouping, Pivot tables, String operation Visualization with Matplotlib: Line plots, Scatter Plots, Visualizing Errors, Density and Contour plots, Histogram, Customizing Plot legends, Color bars, Test and Annotation, Three dimensional Plotting, Geographic data with base map, visualization with sea born. **VISUALIZATION TECHNIQUES**: Arrange tables, Arrange Network and Trees, Map Color and other Channels, Manipulate Views, Facet, Reduce Items and Attributes: Filter, Aggregate, Time-Series Data visualization, Text data Visualization, Multivariate data visualization.

DATA VISUALIZATION USING TABLEAU: **15 Hours** Exploratory Data Analysis using Tableau Visualizations, Creating basic visualizations- Bar Chart, Geographic map, Crosstab Report, Scatter plot, Line Chart, Connecting to Data, Live Connection, Extract Data, Combine data sources, Join tables, Blend data sources, cross-database join, filtering and sorting data, creating groups and hierarchies - Publishing to Tableau Server - Mapping – **Case Study:** Geographic Maps, Filled Maps, Mapping options Heat Map, Choropleth map and highlight table, Histograms, Dashboard Development, - design Principles and Interactivity.	
Total Hours	**45 hours**

Text Books:	
1.	Sosulski K (2018), “Data Visualization made simple: Insights into Becoming Visual, New York: Routledge.
2.	Jake VanderPlas “Python Data Science Handbook”, November 2017.
3.	TamaraMunzner, “Visualization Analysis and Design”, December 2014.
Reference Books:	
1.	Few, Stephen, “Show me the numbers: Designing Tables and Graphs to Enlighten” 2nd Edition. Analytics Press Publishers June 2012
2.	Mathew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications” , 2010
Web References:	
1.	https://datavizproject.com/
2.	https://app.rawgraphs.io/
3.	https://www.datawrapper.de/
4.	https://www.tableau.com/
5.	https://marketing platform.google.com/about/data-studio/
6.	https://cedar.princeton.edu/sites/g/files/toruqf1076/files/media/introduction_to_tableau_training_0.pdf
Online Resources:	
1.	Tableau Desktop 10: Students should download and install the free version of tableau for class use here http://www.tableau.com/academics/students
2.	https://learning.oreilly.com/library/view/visualization-analysis-and/9781466508910/
3.	https://www.udacity.com/course/data-visualization-nanodegree--nd197
4.	https://www.udemy.com/course/mastering-the-art-of-data-visualization-2020/
5.	https://www.datacamp.com/courses/data-visualization-for-everyone

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C601.1	Understand	Quiz	20
C601.2	Analyze	Tutorial	20
C601.3	Apply		

C601.4	Remember	Group Assignment	20
C601.5 & C601.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C601.1	2	3	1		1								1	2	2
C601.2	1	2	2		2								2	1	1
C601.3	3	3	3	3	3								3	3	1
C601.4	1	1	2		1								1	1	1
C601.5	2	1	2	2	1								2	1	2
C601.6		2	2		2								1	1	1

21AD602	AI IN NATURAL LANGUAGE PROCESSING	3/0/3/4.5

Nature of Course	D (Theory Application)
Pre-Requisite	Artificial Intelligence Principles and Techniques

Course Objectives:

1	To learn the fundamentals of natural language processing.
2	To understand the human morphology process.
3	Recognize speech and parts with grammar.
4	To familiarize with concepts of parsing.
5	To apply statistical techniques and create machine translation models.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C602.1	Understand the fundamentals of Natural Language processing.	[U]
C602.2	Realize semantics and pragmatics of English language for text processing.	[U]
C602.3	Analyse POS tagging and select suitable language modelling.	[A]
C602.4	Applying the hidden Markov and Maximum Entropy model.	[AP]
C602.5	Learn about machine translations techniques.	[U]
C602.6	Developing statistical Methods for Real World Applications.	[AP]

Course Contents:

MODULE I: INTRODUCTION

15 Hours

Origin of NLP - knowledge in speech and language processing - Regular Expression - Basic Patterns - Disjunction, grouping, precedence - Finite State Automata - Words and Transducers: English Morphology - Finite state Transducers - Words and Sentence Tokenization - Detecting and Correcting Spelling Errors - Minimum Edit distance - Human Morphological Processing.

MODULE II: WORD LEVEL ANALYSIS **15 Hours**

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models - Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing.

MODULE III: MACHINE TRANSLATION **15 Hours**

Speech recognition architecture - Dialogue and Machine Translation - Dialogue Acts – Automatic, Plan inferential, Cue based Interpretation of Dialogue Acts. **Case Study:** Text Summarization in NLP.

Total Hours:	**45**

Lab Experiments:

1. Implementation of Word Analysis.
2. Creation of Word Generation.
3. Select a word root and fill the add-delete table using morphology.
4. Implementation of N-Grams.
5. Implementation of N-Grams Smoothing.
6. Calculate emission and transition matrix using Hidden Markov Model.
7. Find POS tags of words in a sentence using Viterbi decoding.
8. Study the context and size of the training corpus in learning Parts of Speech.
9. Implement chunking with regular expression.

10. Implement BERT for text classification.	
Total Hours:	**30**
Text Books:	
1	Daniel Jurafsky, James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech”, Pearson Publication, 2018.
2	James Allen, “Natural language Understanding”, Pearson Education, Second Edition, 2020.
3	Nitin Indurkhya and Fred J. Damerau, “Handbook of Natural Language Processing”, Second Edition, Chapman and Hall/CRC Press, 2010.
Reference Books:	
1	Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, Third Edition, OReilly Media, 2019.
Web References:	
1	https://www.coursera.org/specializations/natural-language-processing
2	https://www.simplilearn.com/natural-language-processing-training-course

Continuous Assessment									**End Semester Examination**	**Total**
Theory				**Practical**			**Total (A+B)**	**Total Continuous Assessment**		
Formative Assessment	**Summative Assessment**	**Total**	**Total (A)**	**Formative Assessment**	**Summative Assessment**	**Total (B)**				
80	**120**	**200**	**100**	**75**	**25**	**100**	**200**	**50**	**50**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C602.1	Understand	Quiz	20
C602.2, C602.6	Apply	Tutorial	20
C602.3	Apply	Group Assignment	20
C602.4	Analyze		
C602.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination		
Bloom’s Level	**Summative Assessment (15%) [120 Marks]**	**End Semester Examination (35%) [100 Marks]**

	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination - Practical			
Bloom's Level	**Continuous Assessment (25%) [100 Marks]**		**End Semester Examination (15%) [100 Marks]**
	FA: (75 Marks)	**SA: (25 Marks)**	
Remember	10	10	10
Understand	30	30	30
Apply	40	40	40
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination							
Continuous Assessment (50%)							**End Semester Examination (50%)**
CA 1 (100 Marks)			**CA 2 (100 Marks)**			**Practical Exam (100 Marks)**	**Theory Examination (35%) Practical Examination (15%)**
SA 1 (60M)	**FA 1**		**SA 2 (60M)**	**FA 2**		**FA (75M)** / **SA (25M)**	
	Component-I (20 Marks)	**Component-II (20 Marks)**		**Component-I (20 Marks)**	**Component-II (20 Marks)**		

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C602.1		1	3	3	3							1	3	3	3
C602.2	1	2	3	3	3	1						1	3	3	3
C602.3	2	2	3	3	2							1	3	3	3
C602.4	2	1	3	3	3							1	3	3	3
C602.5	2	1	2	3	2	1						1	3	3	3
C602.6	3	3	3	3	2				2	2		1	3	3	3

21AD603	INTRODUCTION TO COMPUTER NETWORKS	3/0/3/4.5

Nature of Course	C (Theory Concept)
Pre-Requisite	Nil

Course Objectives:

1	To understand the protocol layering and physical level communication
2	To analyze the performance of a network.
3	To understand the various components required to build different networks.
4	To learn the functions of network layer and the various routing protocols
5	To familiarize the functions and protocols of the Transport layer.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C603.1	Understand the basic layers and its functions in computer networks.	[U]
C603.2	Evaluate the performance of a network.	[A]
C603.3	Understand the basics of how data flows from one node to another.	[U]
C603.4	Analyze and design routing algorithms	[A]
C603.5	Design protocols for various functions in the network.	[AP]
C603.6	Examine common Layers and Protocol	[A]

Course Contents:

MODULE I Overview of Data Communication, Networking and Transmission 15 Hours

Introduction: Data Communications - Networks - The Internet - Protocols and standards -The OSI model - TCP/IP Protocol Suite. Data and Signals: Analog and Digital - Transmission Impairment – Performance. Digital Transmission: Line Coding Basics & schemes. Transmission media: Guided Media - Unguided Media. Switching: Circuit Switched Networks, Datagram Networks and Virtual-Circuit Networks.

MODULE II Node to Node and Source to Destination Delivery 15 Hours

Data link layer: Introduction - Error detection and correction (Parity, CRC & Hamming code) - Framing - Flow and Error Control Protocols: Noiseless Channels & Noisy Channels - Multiple Access Protocols – Ethernet: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wi-Fi and Bluetooth. Network layer: Logical Addressing - IPv4, IPv6 Addresses and Packet Formats - Transition from IPv4 to IPv6 - Protocols: Address Mapping, ICMP - Routing algorithms: Forwarding - Unicast routing protocols.

MODULE III Process to Process Delivery and services to users 15 Hours

Introduction to the Transport Layer: Introduction, Transport-layer protocols (Simple protocol, Stop-and-wait protocol-Go-Back-n protocol-Selective repeat protocol-Bidirectional protocols), Transport layer services-User datagram protocol-Transmission control protocol-Standard Client Server Protocols: World wide-web and HTTP-FTP-Electronic Mail-Telnet-Secure Shell- Domain name system.

Total Hours:	**45**

List of Experiments

1. Learn to use commands like tcp dump, net stat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets
3. Applications using TCP sockets like: Echo client and echo server, Chat, File Transfer
4. Simulation of DNS using UDP sockets

5. Write a code simulating ARP /RARP protocols 6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS. 7. Study of TCP/UDP performance using Simulation tool 8. Simulation of Distance Vector/ Link State Routing algorithm. 9. Performance evaluation of Routing protocols using Simulation tools. **10.** Simulation of error correction code (like CRC).	
Total Hours	**30**
Text Books:	
1	AS Tanenbaum, DJ Wetherall, “Computer Networks”, 6th Edition, Prentice-Hall, 2021.
2	Behrouz A. Forouzan Tata McGraw Hill, “TCP/IP Protocol Suite”,Fourth Edition 2010
Reference Books:	
1	Behrouz A. Forouzan “Data Communications and Networking” Fifth Edition TMH, 2013
2	JF Kurose, KW Ross, “Computer Networking: A Top-Down Approach”, 5th Edition, AddisonWesley, 2009.
Web References:	
1	https://nptel.ac.in/courses/106105183/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C603.1&C603.3	Understand	Quiz	20
C603.2	Analyze	Tutorial	20
C603.6	Analyze	Group Assignment	20
C603.4			
C603.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C603.1	3	3	3	2	3	2						2	2	2	2
C603.2	3	3	3	2	3	2						2	2	2	2
C603.3	3	3	3	3	3	2						2	2	2	2
C603.4	3	3	3	2	3	2						2	2	3	3
C603.5	3	3	3	3	3	3						3	3	2	2
C603.6	3	3	3	3	3	3						2			

21AD604	DATA VISUALIZATION LABORATORY	0/0/3/1.5

Nature of Course	Practical

Course Objectives:

1	To Explore data visualization of spreadsheet models in order to provide new insight.
2	To equip the students with knowledge of visual encoding design choices for arranging and representing data in an interactive and spatial form.
3	To gain an insight into Data Visualization techniques and tools.
4	To design visualization dashboard and action.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C605.1	Understand the Spreadsheet model and semi - structured data.	[U]
C605.2	Design oracle database using python	[AP]
C605.3	Understand Tableau and aggregation methods	[U]
C605.4	Demonstrate various Data Visualization Interactive plots using python	[AP]
C605.5	Discover time series using python	[AP]
C605.6	Create Dashboards,actions and storytelling in Tableau	[AP]

Course Contents:

1. Visualization of Spreadsheet Models.
2. Oracle Database Connectivity using Python.
3. Visualization of Semi-Structured Data.
4. Introduction to Tableau and Aggregation Methods in Tableau.
5. Visual Encodings and Basic Dashboards in Tableau.
6. Interactive Plots in Python.
7. Hierarchical and Topographical Data Visualizations in Tableau.
8. Calendar Heat maps and Flow Data Visualizations in Python.
9. Time Series Data Visualization in Python.
10. Dashboards, Actions and Storytelling in Tableau.

Total Hours:	**45**

Text Books:

1	Sosulski K (2018), “Data Visualization made simple: Insights into Becoming Visual, New York: Routledge.
2	Jake VanderPlas “Python Data Science Handbook”, November 2017.
3	TamaraMunzner, “Visualization Analysis and Design”, December 2014.

Reference Books:

1	Few, Stephen, “Show me the numbers: Designing Tables and Graphs to Enlighten” 2nd Edition. Analytics Press Publishers June 2012.
2	Mathew Ward, Georges Grinstein and Daniel Keim, “Interactive Data Visualization Foundations, Techniques, Applications” , 2010.

Web References:

1	https://datavizproject.com/
2	https://app.rawgraphs.io/
3	https://www.datawrapper.de/
4	https://www.tableau.com/

5	https://marketing platform.google.com/about/data-studio/
Online Resources:	
1	Tableau Desktop 10: Students should download and install the free version of tableau for class use here http://www.tableau.com/academics/students
2	https://learning.oreilly.com/library/view/visualization-analysis-and/9781466508910/
3	https://www.udacity.com/course/data-visualization-nanodegree--nd197
4	https://www.udemy.com/course/mastering-the-art-of-data-visualization-2020/
5	https://www.datacamp.com/courses/data-visualization-for-everyone

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyse	30	30	30
Evaluate	10	10	10
Create	-	-	-

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C605.1	2	3	1		1								1	2	2
C605.2	1	2	2		2								2	1	1
C605.3	3	3	3	3	3								3	3	1
C605.4	1	1	2		1								1	1	1
C605.5	2	1	2	2	1								2	1	2
C605.6		2	2		2								1	1	1

21AD605	MINI PROJECT - II	0/0/2/1
Nature of Course	M (Practical Application)	
Pre-Requisites	Programming Languages	

Course Objectives:	
1	To identify a problem area and showcasing a strong understanding of the selected domain.
2	To explore the latest advancements within their selected field of study.
3	To understand and adhere to ethical standards and professional practices in software development.

Course Outcomes: **Upon completion of the course, students shall have ability to**		
C605.1	Identify a problem and carry out a thorough study on the chosen problem	[A]
C605.2	Analyze ongoing developments in the chosen domain and demonstrate technical knowledge pertaining to the same.	[A]
C605.3	Apply suitable tools, techniques, Algorithms, frameworks to solve the practical problems.	[AP]
C605.4	Develop a solution for the chosen problem and validate the results.	[C]

Course Guidelines:

Introduction: Identify domain, Framing Problem Statement, Dataset Collection, Analyze the Techniques, Organize the work flow. **Experiments:** Develop software life cycle model, Implement, and provide solution for the chosen problem statement, Validate the result, and provide the documentation for findings.

1. The entire semester shall be utilized by the students to do their Mini project work by receiving the directions from the project guide.
2. Every student shall have a project guide who is the member of the faculty of the institution for the in-house project or an industry mentor from the industry as project guide for an industry/internship project.
3. Identification of project guide has to be completed by the end of previous semester of the project work to be carried out.
4. The duration may be used for library reading, laboratory work, literature survey, computer analysis or field work as assigned by the guide and also to present periodical seminars about the progress made in the project.
5. Number of students in the project team should be maximum of 4.
6. Students can select project topics from the thrust areas.
7. Projects can be Research Based, Application Based, or Multidisciplinary.
8. Students can choose projects in line with the Departmental Mission, Vision and Program Outcomes.
9. Students can identify the project area / title, obtain the consent of faculty to guide them.
10. Students can make use of college subscribed E-resources like IEEE, ScienceDirect and Elsevier to choose base papers and thereby do literature surveys.
11. After project guide allocation, the student team must meet the respective project guide and update about the status of project periodically.
12. While working on the project, every student team must keep a project diary and record all relevant information. The diary must be verified and signed by the project guide which will be the periodic progress report and submitted during the project review to the project coordinator.
13. Students should not be involved in unethical behaviour, such as plagiarism, copyright violations, etc while working on projects and when submitting project reports.
14. The progress of the project will be evaluated on a continuous basis by conducting periodic internal reviews. The review committee may be constituted by the Head of the Department.

15. A final external project viva-voce examination will be conducted to evaluate the student project work based on oral presentation and the project report by an Internal and External Examiner.
16. Every student team will be required to prepare and submit two (2) copies plus (no. of students) copies of the Project report of typical length 30 – 60 pages (excluding Appendices).
17. The final report shall be in typewritten form as specified in the guidelines issued by the COE.
18. As outcome of the project, students are motivated to publish papers in Scopus Indexed Journals or present the project work in International Conferences.

Summative assessment based on Continuous and End Semester Examination

Activity	Month	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Project Evaluation	August	30	100
Project Evaluation	September	30	
Project Evaluation	October	40	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

Cos	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C605.1	3	3	2	2	1			3	3	3		3	2	3	3
C605.2	3	3	3	3	3			3	2	3	2	3	2	3	3
C605.3	3	3	3	3		3	3	3	3	3	3	3	2	3	3
C605.4	3	3	3	3				3	3	3	3	3	2	3	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

21AD701	DATA ANALYTICS	3/0/0/3

Nature of Course	F (Theory Programming)
Pre-requisite	Cloud Computing

Course Objectives:

1	Understand the Big Data Platform and its use cases
2	Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop
3	Provide an overview of Apache Hadoop
4	To apply Hadoop ecosystem components
5	Develop a big data solution using Hive.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C701.1	Understand the challenges of big data and insights from large and complex datasets.	[U]
C701.2	Recognize the popular big data technologies and platforms used in industry.	[U]
C701.3	Analyse the Big Data framework like Hadoop to efficiently store and process big data.	[A]
C701.4	Design algorithms to solve data Intensive problems using Map Reduce Paradigm.	[AP]
C701.5	Implement and explore the challenges and considerations involved in handling and analysing big data using Hive, HiveQL and Hbase.	[AP]

Course Contents:

INTRODUCTION TO BIG DATA

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Four Vs, Drivers for Big data, Big data analytics, Big data applications-Classification of Analytics - Top Analytics Tools - Apache Spark, Case Study - MongoDB.

HADOOP AND MAP REDUCE PROGRAMMING MODEL

Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop - Hadoop Architecture, Hadoop Storage: HDFS Understanding inputs and outputs of MapReduce - MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression- Application of MapReduce- Case Study : Big-data Management using Map Reduce on Cloud.

HIVE AND HIVEQL, HBASE

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting and Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper. Big-data Management using Map Reduce on Cloud.

Total Hours:	**45**

Text Books:

1	Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publications, First Edition, 2015.
2	Jay Liebowitz,” Data Analytics and AI”,CRC Press; 1st edition, 2020.
3	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007. 2. Tom White “ Hadoop: The Definitive Guide” Third Edition, O‟reilly Media, 2011.

Reference Books:

1	Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013)

2	Tom White, “Hadoop The Definitive Guide”, O’Reilly Publications, Fourth Edition, 2015.
Web References:	
1	https://nptel.ac.in/courses/106104189
2	https://www.coursera.org/learn/google-data-analytics-capstone

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C701.1	Understand	Quiz	20
C702.2	Understand	Tutorial	20
C703.3	Analyze	Group Assignment	20
C704.4	Apply		
C705.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

<table>
<tr><th colspan="6">Assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="5">Continuous Assessment (40%)
[200 Marks]</th><th rowspan="3">End Semester Examination (60%)
[100 Marks]</th></tr>
<tr><th colspan="3">CA 1 : 100 Marks</th><th colspan="2">CA 2 : 100 Marks</th></tr>
<tr><th rowspan="2">SA 1
(60 Marks)</th><th colspan="2">FA 1 (40 Marks)</th><th rowspan="2">SA 2
(60 Marks)</th><th colspan="2">FA 2 (40 Marks)</th></tr>
<tr><th>Component - I
(20 Marks)</th><th>Component - II
(20 Marks)</th><th>Component - I
(20 Marks)</th><th>Component - II
(20 Marks)</th></tr>
</table>

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C701.1	3	3	3	2	3	2						2	2	2	2
C701.2	3	3	3	2	3	2						2	2	2	2
C701.3	3	3	3	3	3	2						2	2	2	2
C701.4	3	3	3	2	3	2						2	2	3	3
C701.5	3	3	3	3	3	3						3	3	2	2

21AD702	DEEP LEARNING AND ITS APPLICATIONS	3/0/0/3

Nature of Course	D (Theory Application)
Pre requisites	Artificial Intelligence

Course Objectives:

1	To understand the basics of deep neural networks.
2	To understand CNN of architectures of deep neural networks.
3	To understand the concepts of Artificial Neural Networks.
4	To learn the basics of Data science in Deep learning.
5	To learn about applications of deep learning in AI and Data Science.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C702.1	Understand the basic concepts of deep learning and principles underlying deep learning.	[U]
C702.2	Design and implement architectures including feed forward networks, Back Propagation Networks and recurrent neural networks.	[A]
C702.3	Apply Convolution Neural Network for image processing.	[AP]
C702.4	Explore concept-based networks for search deep structural and search models.	[U]
C702.5	Apply various deep learning techniques to design efficient algorithms for real-world Applications.	[AP]

Course Contents:

MODULE I DEEP LEARNING ALGORITHMS FOR AI **15 Hours**

Artificial Neural Networks – Linear Associative Networks – Perceptrons -The Backpropagation Algorithm - Hopfield Nets - Boltzmann Machines - Deep RBMs - Variational Autoencoders – Deep Backprop Networks- Autoencoders, LSTM.

MODULE II CONVOLUTIONAL NEURAL NETWORKS **15 Hours**

Convolution Operation - Sparse Interactions - Parameter Sharing - Equivariance - Pooling - Convolution Variants: Strided - Tiled - Transposed and dilated convolutions; CNN Learning: Nonlinearity Functions -- Loss Functions - Regularization - Optimizers - Gradient Computation.

MODULE III APPLICATIONS OF DEEP LEARNING **15 Hours**

Detection in chest X-ray images - object detection and classification -RGB and depth image fusion - NLP tasks - dimensionality estimation - time series forecasting -building electric power grid for controllable energy resources - guiding charities in maximizing donations and robotic control in industrial environments. **Case Study:** Sentiment Analysis.

Total Hours:	**45**

Text Books:

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning", MIT Press, 2016.
2	Stone, James. (2019), “Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning”, Sebtel Press, United States, 2019.
3	Vance, William, “Data Science: A Comprehensive Beginners Guide to Learn the Realms of Data Science”, (Hardcover - 2020), Joining the dots tv Limited.

Reference Books:

1	Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), “Deep Learning Applications”, Volume 3, Springer Publications 2022.
2	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook", Springer International Punlishing, 2018.

Web References:	
1	https://www.oracle.com/artificial-intelligence/machine-learning/what-is-deep-learning/
Online Resources:	
1	https://in.mathworks.com/discovery/deep-learning.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C702.1, C702.3	Understand	Tutorial	20
C702.2	Analyze	Assignment	20
C702.3	Apply	Case Study	20
C702.5	Apply	Quiz	20

Assessment based on Summative and End Semester Examination			
Revised Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	30	20	20
Understand	30	30	20
Apply	20	50	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C702.1	3	3	3	3	3	2			2	2		2	3	2	2
C702.2	3	3	3	3	3	2	2		2	2		2	3	2	2
C702.3	3	3	3	3	2	2	2		2	2		2	3	2	2
C702.4	3	3	3	3	3	2	2		2	2		2	3	3	3
C702.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

21AD703	DATA ANALYTICS LABORATORY	0/0/3/1.5

Nature of Course	J (Problem analytical)
Prerequisites	Data Mining

Course Objectives:

1	To Understand the various hadoop operating modes.
2	To explore file management tasks in Hadoop.
3	To implement Map Reduce programs for processing big data.
4	To solve Big Data problems using pig,hbase,hive commands.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C703.1	Gain hands-on experience with tools such as Hadoop, Hive, PIG and HBase.	[U]
C703.2	Demonstrate the knowledge of big data analytics and implement different file management tasks in Hadoop.	[AP]
C703.3	Implement Map Reduce Paradigm and develop data applications using a variety of systems.	[AP]
C703.4	Analyse and perform different operations on data using Pig Latin scripts.	[A]
C703.5	Illustrate and apply different operations on relations and databases using Hive.	[AP]

Course Contents:

1. Perform setting up and Installing Hadoop in its three operating modes: Standalone, Pseudo distributed, fully distributed.
2. Implement the following file management tasks in Hadoop: Adding files and directories, retrieving files, Deleting files.
3. Create a local directory called "data" on your machine, which contains multiple text files.Upload all the files from the "data" directory to HDFS under the path "/user/example/input". Additionally, create a new directory in HDFS called "output" under the path /user/example/output". Interpret the task using HDFS shell command.
4. Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
5. Analyze time-temperature statistics and generate reports with max/min temperature in weather data using Map Reduce program.
6. Implement matrix multiplication with Hadoop Map Reduce
7. Installation of Pig and Load the input data, tokenize each line into words, group the words, calculate the count for each word, and store the word count result in the specified output directory using pig.
8. Implement the Pig Latin Scripts to find a max temp for each and every year.
9. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
10. Create a table, update, read and delete data using HBase Commands.

Total Hours:	**45**

Text Books:

1	Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publications, First Edition,2015
2	Jay Liebowitz,” Data Analytics and AI”,CRC Press; 1st edition, 2020
3	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007. 2. Tom White “ Hadoop: The Definitive Guide” Third Edition, O‟reilly Media, 2011

Reference Books:

1	Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013)

Web References:

1	https://nptel.ac.in/courses/106104189

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	-	-	-
Apply	60	60	60
Analyze	30	30	30
Evaluate	10	10	10
Create	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C703.1	3	3	1	1	2								3	2	3
C703.2	2	2	1	1	2								3	2	3
C703.3	3	2	3	3	2								3	3	3
C703.4	2	3	3	3	3								3	3	3
C703.5	1	2	3	2	1								3	3	3

21AD704	DEEP LEARNING LABORATORY	0/0/3/1.5

Nature of Course	L (Programming)
Pre requisites	Artificial Intelligence

Course Objectives:

1	To learn deep neural networks and apply for simple problems.
2	To Learn and apply Convolution Neural Network for image processing.
3	To Learn and apply Recurrent Neural Network and its variants for textAnalysis.
4	To explore real world applications with deep neural networks.
5	To learn about applications of deep learning in AI and Data Science.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C704.1	Apply deep neural network for simple problems.	[AP]
C704.2	Apply Convolution Neural Network for image processing.	[AP]
C704.3	Apply Recurrent Neural Network and its variants for text analysis.	[AP]
C704.4	Develop a real-world application using suitable deep neural networks.	[AP]
C704.5	Apply deep learning algorithms for variety applications.	[AP]

Course Contents:

1. Solving XOR problem using Multilayer perceptron.
2. Implement character and Digit Recognition using ANN.
3. Implement the analysis of X-ray image using autoencoders.
4. Implement Speech Recognition using NLP.
5. Develop a code to design object detection and classification for traffic analysis using CNN.
6. Implement online fraud detection of share market data using any one of the data analytics tools.
7. Implement image augmentation using deep RBM.
8. Implement Sentiment Analysis using LSTM.
9. Mini Project: Any application using video analysis.

Total Hours:	**30**

Text Books:

1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning'', MIT Press, 2016.
2	Stone, James. (2019), “Artificial Intelligence Engines: A Tutorial Introduction to theMathematics of Deep Learning”, Sebtel Press, United States, 2019.
3	Vance, William, “Data Science: A Comprehensive Beginners Guide to Learn the Realms ofData Science”, (Hardcover - 2020), Joiningthedotstv Limited.

Reference Books:

1	Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), “Deep Learning Applications”, Volume 3,Springer Publications 2022.
2	Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook'', SpringerInternational Punlishing, 2018.

Web References:

1	https://www.oracle.com/artificial-intelligence/machine-learning/what-is-deep-learning/

Online Resources:

1	https://in.mathworks.com/discovery/deep-learning.html

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
75	25	100	60	40	100

Assessment based on Continuous and End Semester Examination			
Bloom's Level	Continuous Assessment (60%) [100 Marks]		End Semester Practical Examination (40%) [100 Marks]
	FA (75 Marks)	SA (25 Marks)	
Remember	-	-	-
Understand	30	30	30
Apply	30	30	30
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C704.1	3	3	3	3	3	2			2	2		2	3	2	2
C704.2	3	3	3	3	3	2	2		2	2		2	3	2	2
C704.3	3	3	3	3	2	2	2		2	2		2	3	2	2
C704.4	3	3	3	3	3	2	2		2	2		2	3	3	3
C704.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

21AD801	PROJECT	0/0/24/12
Nature of Course	M (Practical Application)	
Pre-Requisites	Programming Languages	
Course Objectives:		
1	To demonstrate technical, interdisciplinary and interpersonal abilities.	
2	To enhance problem-solving and critical thinking abilities through the identification and resolution of technical challenges.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C801.1	Identify the real-life problem from societal need point of view.	[AP]
C801.2	Choose and compare alternative approaches to select most feasible one.	[C]
C801.3	Analyze and synthesize the identified problem from technological perspective.	[A]
C801.4	Design the reliable and scalable solution to meet challenges.	[C]
C801.5	Examine and validate the solution based on the criteria specified.	[A]

Course Guidelines:

1. The entire semester shall be utilized by the students to do their project work by receiving the directions from the project guide.
2. Every student shall have a project guide who is the member of the faculty of the institution for the in-house project or an industry mentor from the industry as project guide for an industry/internship project.
3. Identification of project guide has to be completed by the end of previous semester of the project work to be carried out.
4. The duration may be used for library reading, laboratory work, literature survey, computer analysis or field work as assigned by the guide and also to present periodical seminars about the progress made in the project.
5. Number of students in the project team should be maximum of 4.
6. Students can select project topics from the thrust areas.
7. Projects can be Research Based, Application Based, or Multidisciplinary.
8. Students can choose projects in line with the Departmental Mission, Vision and Program Outcomes.
9. Students can identify the project area / title, obtain the consent of faculty to guide them.
10. Students can make use of college subscribed E-resources like IEEE, ScienceDirect and Elsevier to choose base papers and thereby do literature surveys.
11. After project guide allocation, the student team must meet the respective project guide and update about the status of project periodically.
12. While working on the project, every student team must keep a project diary and record all relevant information. The diary must be verified and signed by the project guide which will be the periodic progress report and submitted during the project review to the project coordinator.
13. Students should not be involved in unethical behaviour, such as plagiarism, copyright violations, etc while working on projects and when submitting project reports.
14. The progress of the project will be evaluated on a continuous basis by conducting periodic internal reviews. The review committee may be constituted by the Head of the Department.
15. A final external project viva-voce examination will be conducted to evaluate the student project work based on oral presentation and the project report by an Internal and External Examiner.

16. Every student team will be required to prepare and submit two (2) copies plus (no. of students) copies of the Project report of typical length 30 – 60 pages (excluding Appendices).
17. The final report shall be in typewritten form as specified in the guidelines issued by the COE.
18. As outcome of the project, students are motivated to publish papers in Scopus Indexed Journals or present the project work in International Conferences.

Summative assessment based on Continuous and End Semester Examination

Activity	Month	Continuous Assessment [60 marks]	End Semester Examination [40 marks]
Project Evaluation	February	30	100
Project Evaluation	March	30	
Project Evaluation	April	40	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)

COs	POs												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C801.1	3	3	2	2	1	2		3	3	3		3	2	3	3
C801.2	3	3	3	3	3	3		3	2	3	2	3	2	3	3
C801.3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3
C801.4	3	3	3	3	2			3	3	3	3	3	2	3	3
C801.5	3	3	3	3	2	3	3	3	2	3	3	3	2	3	3

3	Strongly agreed	2	Moderately agreed	1	Reasonably agreed

21AD901	ARTIFICIAL NEURAL NETWORKS	3/0/0/3

Nature of Course	D (Theory Application)
Prerequisites	Artificial Intelligence Principles and Techniques

Course Objectives:

1.	To understand the fundamentals and applications of artificial neural networks.
2.	To familiarize with the different learning models.
3.	To evaluate model performance and interpret results.
4.	To apply Artificial Neural Network Learning techniques to practical problems.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C901.1	Understand the mathematical foundations of neural network models.	[U]
C901.2	Understand the role of neural networks in engineering, artificial intelligence, and cognitive modelling.	[U]
C901.3	Analyze the concepts and techniques of neural networks through the study of the most important neural network models to apply for suitable applications.	[A]
C901.4	Apply neural networks to particular applications and to know what steps to take to improve performance.	[AP]
C901.5	Design and implement neural network systems to solve real world problems.	[AP]

Course Contents:

INTRODUCTION TO ANN **15 Hours**

Overview of Computational Intelligence and Artificial Evolution - Biological Neuron – Artificial Neural Model - Types of activation functions – Architecture: Feedforward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem. XOR Problem, Multilayer Networks. Learning: Learning Algorithms, Error correction and Gradient Descent Rules, Hebbian Learning, Perceptron Learning Algorithm, Perceptron Convergence Theorem - Data Normalization.

SUPERVISED AND UNSUPERVISED TRAINING METHODS **15 Hours**

Single layer perceptron, Multilayer Perceptron, Back Propagation Networks, Radial Basis Function Networks, Convolutional Neural Networks, Recurrent Networks - Hopfield Network - Self Organization Maps - Boltzmann machines – Auto Encoders - Brain-State-in- a Box Network - Associate Memory Network - Associative memory models.

APPLICATIONS OF ANN	**15 Hours**
Function Approximation - Cardiopulmonary Modeling, Pattern Recognition - Tree Classifier Example - Handwritten Pattern Recognition - Self Organization - Serial Killer Data Mining Example, Pulse coupled Neural Networks - Image Segmentation Example. **Case study:** ANN in Retail.	
Total Hours:	**45**

Text Books:	
1.	Kevin L. Priddy and Paul E.Keller, “Artificial Neural Networks: An Introduction”,SPIE Press, 2005.
2.	Simon S Haykin, “Neural Networks a Comprehensive Foundations”, PHI Education, 2010.
3.	Satish Kumar, “Neural Networks A Classroom Approach”, McGraw Hill Education (India) Pvt. Ltd, Second Edition, 2017.
Reference Books:	
1.	B. Yegnanarayana, “Artificial Neural Networks”, PHI Learning Pvt. Ltd, 2010.
2.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), Blayke’s Books, 2017.
Web References:	
1.	https://www.educba.com/types-of-neural-networks/
2.	https://drive.google.com/file/d/0B2iRDvP8jUuAUnpfaDBnQTBWLUU/edit?resourcekey=0-bq1kH6l5hurYT7TtvylSCQ

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C901.1	Understand	Quiz	20
C901.2	Understand	Tutorial	20
C901.3	Analyze	Group Assignment	20
C901.4	Apply		
C901.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C901.1	3	3	3	2	3	1	1	1	1		1	2	2	2	2
C901.2	3	3	3	2	3	1	1	1	1		1	2	2	2	2
C901.3	3	3	3	3	3	1	1	1	1		1	2	2	2	2
C901.4	3	3	3	2	3	1	1	1	1		1	2	2	3	3
C901.5	3	3	3	3	3	1	1	1	1		1	3	3	2	2

21AD902	SEMANTIC WEB	3/0/0/3
Nature of Course	F (Theory)	

Course Objectives:

1	To learn the fundamentals of semantic web and to conceptualize and depict ontology for semantic web
2	To make a study of languages for semantic web.
3	To learn about the ontology learning algorithms and to utilize them in the development of an application.
4	To explore appropriate semantic web services and tools for semantic description based on chosen problem domain.

Course Outcomes:

Upon completion of the course, students shall have ability to

C902.1	Explain how the semantic web technology concept has revolutionized the World Wide Web.	[U]
C902.2	Describe the fundamental concepts in Semantic Web as well as analyze the Classification of Ontologies	[U]
C902.3	Design semantic web meta data and RDF schema	[AP]
C902.4	Interpret Web service security standards and service models in semantic web services to implement writing rules	[AP]
C902.5	Develop an application using ontology languages and tools.	[AP]

Course Contents:

MODULE I: SEMANTIC WEB AND ONTOLOGY ENGINEERING 15 hours

Introduction to the Syntactic web and Semantic web – Evolution of the Web, The Visual and Syntactic Web, Levels of Semantics – Components of Semantic Web – Metadata for web information – Semantic Web Architecture and Technologies: Contrasting Semantic with Conventional Technologies, Semantic Modeling – Ontological Engineering: Ontologies – Classifying Ontologies – Terminological aspects: Concepts, terms, Complex Objects, Subclasses, Upper Ontologies – Ontology Development process and Life Cycle – Methods for Ontology Learning.

MODULE II: LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 15 hours

Web Documents in XML – RDF – Schema – Web Resource Description using RDF – RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics Pragmatics –

Traditional Ontology Languages: Ontolingua and KIF – LOOM – OKBC – OCML – FLogic – Ontology Markup Languages: SHOE – XOL – RDF – OIL – DAML + OIL – OWL.

MODULE III: SEMANTIC WEB SERVICES AND TOOLS **15 hours**

Introduction – Web Service Essentials: Components of a Web Service – Web Service Security standards – Web Service standardization organizations – OWL-S Service Ontology: Overview – Service Profile – Service Model – Service Grounding – OWL-S Example – Semantic Web Software Tools: Metadata and Ontology Editors – Dublin Core Metadata Editor – OilEd – WebOnto – OntoSaurus – WebODE – OntoEdit – KAON. Case Study: Supply chain Management, Healthcare and Lifesciences.

Total Hours:	**45**

Text Books:

1	Grigoris Antoniou and Frank Van Harmelen, “A Semantic Web Primer”, The MIT Press, Cambridge, Massachusetts London, England, Edition 3,2012.
2	Breitman, Karin, Casanova, Marco Antonio Truszkowski Walt, “Semantic Web: Concepts Technologies and Applications”, Springer Science and Business Media, 2017.

Reference Books:

1	Pascal Hitzler, Markus Krötzsch and Sebastian Rudolph ,”Foundations of Semantic Web Technologies” Chapman & Hall / CRC, 2009
2	Jorge Cardoso,“Semantic webservices: Theory, tools and applications”, Information science, 2007.

Web References:

1	http://www.cs.jyu.fi/ai/vagan/itks544.html
2	http://videolectures.net/iswc08_hendler_ittsw/

Online Resources:

1	https://www.w3.org/standards/semanticweb/
2	https://cambridgesemantics.com/blog/semantic-university/intro-semantic-web/
3	https://devopedia.org/semantic-web

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C902.1	Understand	Quiz	20
C902.2	Understand	Tutorial	20
C902.3	Apply	Group Assignment	20
C902.4	Apply		
C902.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C902.1	3	3	3	2	3	2						2	2	2	2
C902.2	3	3	3	2	3	2						2	2	2	2
C902.3	3	3	3	3	3	2						2	2	2	2
C902.4	3	3	3	2	3	2						2	2	3	3
C902.5	3	3	3	3	3	3						3	3	2	2

21AD903	VIRTUAL REALITY AND AUGMENTED REALITY	3/0/0/3

Nature of Course	C (Theory Concept)
Prerequisites	Nil

Course Objectives:

1	To understand the basic concepts of Virtual Reality.
2	To know input and output devices of virtual Reality.
3	To understand the interaction techniques of VR.
4	To outline the design and evaluation methods in VR.
5	To discuss applications of VR in various industries.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C903.1	Understand the requirements of virtual and augmented reality.	[U]
C903.2	Know the usage of hardware and software in VR.	[R]
C903.3	Discover the various manipulation and interactive techniques.	[AP]
C903.4	Compare the difference between augmented and virtual reality.	[AP]
C903.5	Implement Virtual/Augmented Reality Applications.	[A]

Course Contents:

MODULE I Introduction to Virtual Reality **15 Hours**

History of VR – Key Elements of VR - VR Paradigms - Input: User Monitoring – World Monitoring - Output devices: Visual Displays – Visual Representation in VR (Aural and Haptic) – Navigation. .

MODULE II Visual Rendering , Perception and Interactive Technique **15 Hours**

Visual Rendering - Depth perception - Motion perception - Stroboscopic Apparent Motion - Color perception – 3D Manipulation task and technique - Interactive Techniques in Virtual Reality: Body Track - Hand Gesture - 3D Manus - Object Grasp - Features of augmented reality, Difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, Visualization techniques for augmented reality.

MODULE III – Design and 3D interfaces **15 Hours**

Experience Designs – The Process for Designing User Experience for Virtual Reality - Three I's of VR - Immersion, Interaction, Imagination - Emotional Experience – Social Experience - Evaluation of VR – 3D Unity Architecture – Graphics – VR interfaces and AR Kit support – Application of AR and VR - **Case study:** AR and VR in Industry.

Total Hours:	**45**

Text Books:

1	Alan B Craig, William R Sherman, Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann Publishers, 2009.
2	Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494.
3	Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.
4	Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.

Reference Books:

1	Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Inter science, India, 2003.
2	William R Sherman and Alan B Craig, "Understanding Virtual Reality, Interface, Application and Design",(The Morgan Kaufmann Series in Computer Graphics)", Morgan Kaufmann Publishers, San Francisco, CA, 2002

3	Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Merging Real and Virtual Worlds”, 2005.
Web References:	
1	http://lavalle.pl/vr/book.html
2	https://www.coursera.org/learn/introduction-virtual-reality
3	https://uxplanet.org/designing-user-experience-for-virtual-reality-vr-applications-fc8e4faadd96
4	https://virsabi.com/virtual-reality-experience-design/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C903.1	Understand	Quiz	20
C903.2	Analyze	Tutorial	20
C903.3	Understand	Group Assignment	20
C903.4	Analyze		
C903.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C903.1	2	1	3		3								3	3	3
C903.2	3	3	2	3	2								3	2	3
C903.3	3	3	2										3		3
C903.4	2	1	2										2		2
C903.5	2	1	2	3				1	1	1	1	1	3	3	3

21AD904	BIO INFORMATICS	3/0/0/3

Nature of Course	H (Theory Technology)
Prerequisites	Data Warehousing and Mining

Course Objectives:

1	To identify the need and role of bioinformatics technologies and apply this to the solution of biological problems.
2	To discover biological data, interpret and apply data warehousing and data mining in bioinformatics.
3	To examine appropriate models, data visualization techniques and model biological information.
4	To apply genome annotation, gene prediction, phylogenetic analysis and microarray analysis technologies.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C904.1	Interpret the need and role of bioinformatics data and technologies.	[U]
C904.2	Determine the models for biological data analysis and visualize the bioinformatics data.	[AP]
C904.3	Apply pattern matching techniques to bioinformatics data like protein data and genomic data.	[AP]
C904.4	Illustrate the use of technologies for genome annotation, gene prediction and phylogenetic analysis.	[AP]
C904.5	Apply micro array technology for genomic expression study and analysis.	[AP]

Course Contents:

MODULE I Bioinformatics data and technologies **15 Hours**

Need for Bioinformatics technologies – Overview of Bioinformatics technologies - Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System. Data warehousing and Data mining in Bioinformatics - Bioinformatics data – Data warehousing architecture – Data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics.

MODULE II Modeling, Pattern Matching And Visualization **15 Hours**

Hidden markov modeling for biological data analysis – Sequence identification – Sequence classification – Multiple alignment generation – Comparative modeling – Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks - Molecular modeling – Computer programs for molecular modeling - Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models - Game representation of Biological sequences – DNA, Protein, Amino acid sequences.

MODULE III Applications **15 Hours**

Genome Annotation and Gene Prediction; ORF finding- Genome analysis; Phylogenetic Analysis: Comparative genomics, orthologs, paralogs. Microarray Analysis. Microarray technology for genome expression study, image analysis for data extraction, preprocessing, segmentation, gridding, spot extraction, normalization, filtering, cluster analysis, gene network analysis, Compared Evaluation of Scientific Data Management Systems, Cost Matrix, Evaluation model - Benchmark – Tradeoffs. **Case study:** Genome Analysis of SARS-CoV-2, BLAST, Bioinformatics Databases.

Total Hours: 45

Text Books:

1	Yi-Ping Phoebe Chen, “BioInformatics Technologies”, Springer Berlin Heidelberg, 2014.
2	Arthur K. Lesk, “Introduction to Bioinformatics”, Oxford University Press, 2019.
3	Bryan Bergeron,”Bio Informatics Computing”, Second Edition, Pearson Education, 2003.

Reference Books:

1	Pierre Baldi and Soren Brunak, “Bioinformatics, The Machine Learning Approach”, MIT Press, 2001.
2	Zoe Lacroix and Terence Critchlow, “BioInformatics, Managing Scientific data”, Elsevier, 2003.
3	Stanley I. Letovsky ,”Bioinformatics: Databases and Systems”, Springer; 2006.
4	D.E. Krane and M.L. Raymer, “Fundamental concepts of bioinformatics”, Pearson Education, 2006.
Web Resources:	
1	https://onlinecourses.nptel.ac.in/noc21_bt06/preview
3	https://www.coursera.org/learn/bioinformatics
Online References:	
1	http://bioinfo.mbb.yale.edu/mbb452a/intro/
3	https://serc.carleton.edu/exploring_genomics/chamaecrista/bioinformatics_.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C904.1	Understand	Quiz	20
C904.2	Apply	Tutorial	20
C904.3	Apply	Group Assignment	20
C904.4	Apply		
C904.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30

Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C904.1	3	3	3	2	3							2	3	3	3
C904.2	3	3	3	2	3							2	3	3	2
C904.3	3	3	3	3	3							2	3	3	2
C904.4	3	3	3	2	3							2	3	3	3
C904.5	3	3	3	3	3							3	2	2	2

21AD905	INTERNET OF THINGS	3/0/0/3
Nature of Course	D (Theory Application)	
Pre requisites	Nil	
Course Objectives:		
1.	To understand the fundamentals of IoT, basic design and process modelling.	
2.	To understand various IoT protocols like COAP, MQTT etc.	
3.	To build simple and low cost IoT applications using any open-source software tools.	
4.	To understand the design constraints of real world IoT applications and to apply the concept of Internet of Things in real world scenarios.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C905.1	Infer the fundamental knowledge on Internet of Things.	[U]
C905.2	Build IoT systems using Raspberry Pi, Arduino, Node MCU on Embedded Platform.	[AP]
C905.3	Relate the market perspectives on Internet of Things.	[U]
C905.4	Examine the application of IoT in Industrial Automation and identify the Real-World Design Constraints.	[A]
C905.5	Examine IoT applications in different domains and analyze their performance	[A]

Course Contents:

FUNDAMENTALS AND PROTOCOLS OF IOT **15 Hours**

Introduction to IoT – Evolution of IoT – Characteristics – IoT Enabling Technologies – IoT Architecture - Functional Blocks of IoT – IoT Protocols – HTTP, MQTT, COAP, Web Sockets, XMPP, IPv6 Low Power Communications: 6LoWPAN, Bluetooth Low Energy, Zigbee, IEEE 802.15.4,WiFi – IoT Communication Models – IoT Communication APIs – IoT Levels – IoE vs IoT vs M2M – SDN and NFV for IoT - Domain Specific IoT - IoT Challenges.

IOT DESIGN AND SYSTEM HARDWARE **15 Hours**

Sensors & Actuators - IoT Design Methodology **Arduino:** Physical Design – Interfaces – Arduino IDE – Arduino Programming with examples: Digital IO – Analog IO – Serial Communication – Condition and Looping statements – Programming using ESP8266 Node MCU. **Raspberry Pi:** Physical Design – Interfaces – Raspberry Pi programming using Python with examples – Python Packages for IoT.

CLOUD FOR IOT WITH REAL TIME APPLICATIONS **15 Hours**

Types of Cloud - loT with Cloud challenges - Selection of cloud for loT applications - Fog computing for loT - Edge computing for loT – IoT Data Lake – Role of Machine Learning - IoT Security. **Case studies:** AWS / Thing Speak / AZURE IoT Hub / Things Board / Adafruit IO

Total Hours	**45**

Text Books:	
1.	Hanes David, Salgueiro Gonzalo, Grossetete Patrick, Barton Rob, Henry Jerome, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things”, Pearson Education, 2017.
2.	ArshdeepBahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach”, Universities Press, 2015, ISBN: 978-81-7371-954-7.

3.	Mark Torvalds, “Arduino Programming: Step-by-step guide to mastering arduino hardware and software”, 2nd Edition, 2018.
Reference Books:	
1.	Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw Hill Education, 2017.
2.	Srinivasa K. G, Siddesh G. M., Hanumantha Raju R., “Internet of Things”, Cengage Learning India Pvt. Ltd., 1st Edition, 2018.
3.	Dr. Simon Monk, “Programming the Raspberry Pi: Getting Started with Python”, 2nd Edition, McGraw-Hill Education, 2016.
4.	Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, “Internet of Things”, Wiley Publication, 2nd Edition, 2020.
Web References:	
1.	https://github.com/connectIOT/iottoolkit
2.	https://www.arduino.cc/
3.	http://www.buyya.com/papers/IoT-Book2016-C1.pdf
4.	https://www.ptc.com/en/technologies/iiot
5.	http://wwwusers.di.uniroma1.it/~spenza/files/labIoT2015/Lab-IoT-1.pdf
Online Resources:	
1.	https://nptel.ac.in/courses/106/105/106105166/
2.	https://www.coursera.org/learn/iot
3.	http://www.iotlab.eu/
4.	http://www.libelium.com/resources/top_50_iot_sensor_applications_ranking/
5.	https://www.edx.org/course/introduction-to-the-internet-of-things-iot

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C905.1	Understand	Quiz	20
C905.2	Analyze	Tutorial	20
C905.3	Understand	Group Assignment	20
C905.4	Analyze		
C905.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Mapping of Course Outcomes (CO) with Programme Outcomes (PO) Programme Specific Outcomes (PSO)															
Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C905.1	1	1	2		1	2	1			1		1	3	3	1
C905.2	3	3	3	3	3	1	2			1		2	3	3	3
C905.3	1	2	1	1	2		1		1		1	2	1	1	
C905.4	1	2	3	3	2	2	2			1		1	2	3	2
C905.5	3	3	3	3	3		1		2	1		1	2	3	2

21AD906	APP DEVELOPMENT	0/0/6/3

Nature of Course	F (Theory Programming)
Pre-Requisite	Cloud Computing

Course Objectives:

1	To discuss the essence of front-end development skills.
2	To impart the knowledge of React components used in Spring boot development platforms.
3	Ability to understand and use Setup Cloud API.
4	To deploy and test the React App used in Spring Boot.
5	To learn the Spring Cloud concepts using Docker.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C906.1	Identify the basic concepts and design issues of React.	[R]
C906.2	Understand the principles of process and Spring boot.	[U]
C906.3	Illustrate the approaches in scheduling and Spring Cloud to apply in real world problems.	[AP]
C906.4	Apply concepts of Micro services Communication to the issues that occur in Real time applications.	[AP]
C906.5	Identify issues related to Docker, API Gateway.	[AP]
C906.6	Examine common React, Availability and Scalability.	[A]

Course Contents:

MODULE 1 REACT INTRODUCTION **15 Hrs**

Components, Routes, State, Props, hooks, Higher Order Functions, Axios and Services, Ant Design. **Redux:** Core Concept, Data Flow, Store, Actions, Pure function, Reducers, Devtools, Middleware, Webpack, Redux Integration. **Spring boot: Annotations**, Beans, Configuration, HTTP Methods, Crud, Postman Overview. Spring Security: Authentication, Authorization, Security Implementation. Configure Security, Authentication Manager, HTTP Security, Circular Reference Error.JWT Implementation: JWT Overview, JWT Libraries, Helper Methods, Token Generation and Validation, Implementing JWT Authorization, Filter. **OAUTH Implementation** : Introduction, Sample flow, Authorization code grant type flow,Implicit grant flow,Password Grant Type flow, Client, Credential Grand type flow, Refresh token Grand type flow,Validating token,Oauth2 integration with Spring Security. **Building Micro services :** Monolith Architecture and Challenges of Monolith Architecture, What is Micro services & How It Solves the Challenges of Monolith Architecture, Micro services Architecture Benefits and Best Practices, Understanding Spring Cloud and It's Important Modules, Micro service Applications and It's Port Mapping.

MODULE II MICROSERVISES COMMUNICATION OVERVIEW **15 Hrs**

Micro services Communication using Rest Template, Micro services Communication using Web Client, Micro services Communication using Spring Cloud Open Feign - Understanding service Registry - Spring Cloud Netflix Eureka Server Implementation, Update on Using Spring Boot 3 Version, Register Micro service as Eureka Client, Update on using Spring Boot 3 Version, Register Micro service as Eureka Client, Running Multiple Instances of Micro service, Load Balancing with Eureka, Open Feign and Spring Cloud Load Balancer API gateway using Spring Cloud gateway: Understanding API Gateway - Create and Set up API Gateway Micro service, Update on Using Spring Boot 3 Version, Register API-Gateway as Eureka Client to Eureka Server, Configuring API Gateway Routes and Test using Postman Client, Using Spring Cloud Gateway to Automatically Create Rout.

MODULE 3 CENTRALIZED CONFIGURATIONS USING SPRING CLOUD CONFIG SERVER **15 Hrs**

How to Use Spring Cloud Config Server, Create and Setup Spring Cloud Config Server Project in IntelliJ IDEA, Update on Using Spring Boot 3 Version, Register Config-Server as Eureka Client, Set up Git Location for Config Server, Refactor Department-Service to use Config Server, Refactor Employee-Service to use Config Server, Refresh Use case - No Restart Required After Config Changes,REACT Frontend Micro service: Create React App using Create React App Tool, Adding Bootstrap in React Using NPM, Write HTTP Client Code to Connect React App with API-Gateway (REST API Call), Create a React Component and Integrate with API Gateway Microservice, RabbitMQ Core Concepts: RabbitMQ Architecture, Install and Setup RabbitMQ using Docker, Explore RabbitMQ using RabbitMQ Management UI, Create and Setup Spring Boot 3 Project in IntelliJ, Connection Between Spring Boot and RabbitMQ, Configure RabbitMQ in Spring Boot Application, Create RabbitMQ Producer, Create REST API to Send Message, Create RabbitMQ Consumer, Configure RabbitMQ for JSON Message Communication, Create RabbitMQ Producer to Produce JSON Message, Create REST API to Send JSON Object, Create RabbitMQ Consumer to Consume JSON Message, Dockering Spriing boot App : Install Docker Desktop, General Docker Workflow, Create Spring Boot Project and Build Simple REST API, Create Docker file to Build Docker Image, Build Docker Image from Dockerfile, Run Docker Image in a Docker Container, Push Docker Image to Docker Hub, Pulll Docker Image from DockerHub

	Total Hours:	**45**

Text Books:

1	Merih Taze, “Engineers Survival Guide: Advice, tactics, and tricks After a decade of working at Facebook, Snapchat”, Microsoft Paperback – November 28, 2021.
2	Gerardus Blokdyk, “Secure Microservices A Complete Guide”, Edition Paperback – July 17, 2021.
3	Theo H King, “Aws: The Ultimate Guide from Beginners to Advanced For the Amazon Web Services”, (2020 Edition), Paperback – Import, 21 December 2019.

Reference Books:

1	Craig zacker, “Exam ref pl-900 Microsoft power platform”, paperback – 8 February 2021.

Web References:

1	https://awscloud.in/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination			
Bloom’s Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	

Remember	-	-	-
Understand	20	20	20
Apply	40	40	40
Analyse	40	40	40
Evaluate	-	-	-
Create	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C906.1	3	3	3	2	3	2						2	2	2	2
C906.2	3	3	3	2	3	2						2	2	2	2
C906.3	3	3	3	3	3	2						2	2	2	2
C906.4	3	3	3	2	3	2						2	2	3	3
C906.5	3	3	3	3	3	3						3	3	2	2
C906.6	3	3	3	2	3	2						2	2	3	3

21IT901	UI/UX APPLICATION DEVELOPMENT	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Java Programming	

Course Objectives:

1.	To create responsive one page web application using front-end technologies.
2.	To develop JavaScript based web application.
3.	To integrate the knowledge of React components and NodeJS.
4.	To understand the purpose of JSON package creation.
5.	To explore the knowledge of REST services and integration of Sonar Cloud.

Course Outcomes

Upon completion of the course, students shall have ability to

C901.1	Demonstrate the client-side HTML application development using REACT	[U]
C901.2	Illustrate the use of JavaScript in REACT applications.	[U]
C901.3	Apply CSS for designing REACT applications.	[AP]
C901.4	Develop simple applications using JSON packages.	[AP]
C901.5	Create simple applications using REST API	[AP]
C901.6	Analyze Code Quality by integrating Sonar Cloud.	[A]

Course Contents:

Front End Development Environment Setup **15 Hours**

Use Case Definition – Requirement Analysis -Overview on HTML, CSS-Overview of JavaScript – Introduction to NodeJS Installation of NodeJS-Introduction to React -ReactCLI -React Overview-Integrating Front-end with Backend

React and its components **15 Hours**

Virtual DOM – Components -Child Components-Namespace Components-Node Setup-NPM utility -JSON package creation and its purpose -ES6 features

Integrating RestAPI and SonarCloud **15 Hours**

Component Props – Component state with Hooks-Decomposing Components-Editable table -Class based Components – Integrating Rest Services –GET, POST, PATCH, PUT, DELETE Component Rendering-Component state -component Updating-Component Error Handling-Testing -Deployment in Heroku and Netlify.GitHub repository and maintain source code of the application – Sonar cloud integration for code Quality Analysis

Total Hours	**45**

Text Books:

1.	Shama Hoque, “Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js”, 2nd Edition, Packt Publishing, 2020.

Reference Books:

1.	Andrea Chiarelli, “Beginning React: Simplify your frontend development workflow and enhance the user experience of your applications with React”, Packt Publishing, 2018.

2.	Somnath Mukherjee, “RESTfulness: Easy and Quick way to understand REST, Web API, with practical examples and coding”, Notion Press, 2020
Web References:	
1.	https://cloudinary.com/guides/front-end-development/front-end-development-the-complete-guide
2.	https://www.coursera.org/learn/html-css-javascript-for-web-developers
3.	https://www.udemy.com/course/react-the-complete-guide-incl-redux/
4.	https://developer.mozilla.org/en-US/docs/Learn/JavaScript/Objects/JSON
5.	https://github.com/apps/sonarcloud
Online Resources:	
1.	https://www.freecodecamp.org/news/html-css-and-javascript-explained-for-beginners/
2.	https://www.tutorialsteacher.com/nodejs
3.	https://www.w3schools.com/REACT/DEFAULT.ASP
4.	https://www.astera.com/type/blog/rest-api-integration/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C901.1	Understand	Assignment	20
C901.2, C901.3	Understand, Apply	Case Study	20
C901.4, C901.5	Apply	Online Quiz	20
C901.6	Analyse	Case Study	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	10
Understand	50	30	40
Apply	30	40	40
Analyse	-	10	10
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C901.1	3	3	3	3	2							2	3	2	2
C901.2	3	3	3	2	3							2	2	3	2
C901.3	3	3	2	3	3							3	3	3	2
C901.4	3	3	2	2	3							2	3	3	3
C901.5	3	2	3	2	3							2	2	2	2
C901.6	3	2	2	2	2							2	3	2	2

21IT902	ADVANCED APPLICATION DEVELOPMENT	0/0/6/3
Nature of Course	M (Practical Application)	
Pre-Requisite	Web Frameworks, Web Development using REACT, Cloud Computing, App Development	

Course Objectives:	
1	To discuss the essence of front-end development skills in real world applications.
2	To impart the knowledge of creating backend business logics for business scenarios.
3	To integrate frontend and backend applications with security features.
4	Ability to understand and use Setup Cloud API, Docker services, etc.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C902.1	Apply the basic concepts and design Front End for real world applications.	[AP]
C902.2	Apply the basic concepts and implement Backend business logic for real world applications.	[AP]
C902.3	Illustrate the security related features and apply security concepts in real world business applications.	[U]
C902.4	Illustrate the process of Integrating front end and back-end application and deploy them in Cloud.	[U]
C902.5	Apply EC2 instances, configuring networking, and deploying Dockerized applications and also apply insights into DevOps practices related to continuous integration and deployment.	[AP]
C902.6	Demonstrate the ability to create private routes, manage user sessions, and integrate various features like user profiles, job applications, and skills panels.	[AP]

Course Contents:

MODULE I Front End **15 Hours**

Setting up React Project Environment using Vite Template, Folder Structure, and GitHub. Setting up React Project Environment using Vite Template, Folder Structure, and GitHub. Design and Component Analysis, along with the Frontend Module Report. Implement the preloader concept using React's <Suspense>Design the side bar and top bar components for the admin and user panels using TailwindCSS. Designing unprotected routes for the front landing page, search, login, register, terms and conditions, privacy, 404 policies, and contact. Designing the Navbar and Footer, as well as components for job listings (Landing page design), and Login & Register. Designing components for tracking applied jobs and job history. Designing components for editing phone number, email, and password. Designing a Skills Panel for adding and editing skills related to education, certifications, experience, Git links, etc. Designing components for a Premium Job Suggestions panel, Payment, and Membership & Subscriptions. Designing components for User Listing (Premium/Normal) & Applicants Listing, as well as History Tables. Create User CRUD (Create, Read, Update, Delete) Components. Designing components for Jobs Listing and History Tables based on job listing type (Premium/Normal). Create Job CRUD (Create, Read, Update, Delete) Components. Designing CRUD components for Membership Plans.Designing components for Admin Profile & Password, Payment Methods, and Site Settings.

MODULE II Back End **15 Hours**

Planning and setting up required modules, workspace, and an online PostgreSQL database (SQL DB). Planning the database schema based on requirements. Implementing User & Admin, Jobs, and Membership models along with their relationship definitions. Implementing Roles (User & Admin), Request & Response DTOs for all models, and Auth DTO. Setting up HTTP filters, session policies, CORS, and CSRF configurations. Configuring JWT Filter Chain and JWT Token (Secret, Expiry, Token Body) configurations. Implementing services for all models, including business logic, data validation, and interaction with the database. Implementing CRUD controllers and authentication controllers with endpoint security based on role-based access control. Setting up Swagger Tags for all Endpoints.

MODULE III Integration and Deployment **15 Hours**

Writing API services with Axios in React. Implementing private routes using React Router or another routing library. Storing user data in Local Storage and managing session tokens in Session Storage. Integrating job listing components into the landing page with the assistance of Redux & Redux Toolkit. Integrating Login & Register, managing User Sessions using Session Tokens Integrating Profile & Membership Integrating Job Application Integrating Skills component Integrating Admin Authentication, managing Admin Sessions using Session Tokens Integrating User Components Integrating Jobs Components Integrating Membership Components Integrating Admin Profile Integrating payment gateways like Razor pay and CCAvenue in the Admin Panel. Creating a network security group and setting inbound and outbound rules Setting up an EC2 instance with either an AMI or Ubuntu micro instance. Installing and configuring Docker inside the EC2 instance. Adding PostgreSQL drivers in the POM file and updating local database properties to Neon credentials. Setting up a Dockerfile containing Java version and Spring Boot version configurations for the backend. Building the Docker image inside the EC2 instance using the Dockerfile and starting the backend container with the Dockerfile. Setting up a Dockerfile containing Node.js version and Nginx version configurations for the frontend. Building the Docker image inside the EC2 instance using the Dockerfile and starting the frontend container with the Dockerfile.

Total Hours: 45

Text Books:

1	Merih Taze, “Engineers Survival Guide: Advice, tactics, and tricks After a decade of workingat Facebook, Snapchat”, Microsoft Paperback, 2021.
2	Nigel Poulton, “Docker Deep Dive: Zero to Docker in a Single Book” - 2023 Edition (Full Colour Print), 2023
3	Theo H King, “Aws: The Ultimate Guide from Beginners to Advanced For the Amazon Web Services”, (2020 Edition), Paperback – Import, 2019.

Reference Books:

1	Craig zacker, “Exam ref pl-900 Microsoft power platform”, paperback, 2021.

Web References

1	https://awscloud.in/
2	https://jwt.io/introduction/

3	https://spring.io/guides
4	https://redux.js.org/
5	https://www.postgresql.org/docs/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
75	**25**	**100**	**60**	**40**	**100**

Assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment (60%) [100 Marks]**		**End Semester Practical Examination (40%) [100 Marks]**
	FA (75 Marks)	**SA (25 Marks)**	
Remember	-	-	-
Understand	40	40	40
Apply	60	60	60
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C902.1	3	3	3	3	3	2		2	2	2	2	2	3	3	3
C902.2	3	3	3	3	3	2		2	2	2	2	2	2	2	3
C902.3	3	3	3	3	3	2		2	2	2	2	2	3	3	3
C902.4	3	3	3	3	3	2		2	2	2	2	2	2	3	3
C902.5	3	3	3	3	3	2		2	2	2	2	2	3	2	3
C902.6	3	3	3	3	3	2		2	2	2	2	2	3	2	3

21AD912	BAYESIAN DATA ANALYSIS	3/0/0/3

Nature of Course	G (Theory Analytical)
Pre-requisite	Nil

Course Objectives:

1	To learn basic concepts of Bayesian analysis.
2	To introduce the Bayesian concepts and methods with emphasis on data analysis.
3	To assess the outcome of prior distributions as well as posterior means.
4	To identify the optimal model and to learn how to apply the same in suitable applications.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C912.1	Understand the basics of probability and relate it to the Bayesian inference.	[U]
C912.2	Apply the inference rules customized for single parameter models.	[AP]
C912.3	Examine the simulation environment for generation of inferences by utilizing various algorithms.	[A]
C912.4	Analyze the inference mechanism for multi-parameter and hierarchical models.	[A]
C912.5	Identify multiple modeling algorithms for predictive analysis and evaluate the outcome metrics	[AP]
C912.6	Apply the inference mechanism effectively in different nonlinear models.	[AP]

Course Contents:

SINGLE PARAMETER MODELS: 15 Hours

Introduction to Probability, Priors and Posterior Analysis, Statistical Models, The Bayes inference. Bayes Rule, Normal model, Conjugate model, Binomial model, Posterior Distribution and Inferences. Markov Chain Monte Carlo simulation, RJags, The Metropolis-Hasting algorithm, Gibbs Sampler, Approximation based on posterior modes.

MULTI-PARAMETER AND HIERARCHICAL MODELS: 15 Hours

Multi-parameter -Normal data with non-informative, conjugate, and semi-conjugate prior distributions, Multivariate normal model, Hierarchical - Exchangeability and setting up, Computation. Bayesian Data Analysis: Model checking, Evaluating, comparing, and expanding models, modeling accounting for data collection, Decision analysis.

NON-LINEAR MODELS: 15 Hours

Mixture models- Setting up and interpreting mixture models, Gaussian process models Multivariate models- Non - normal models and multivariate regression surfaces. Comparison of Population: Inference for Proportions, Inference for Normal Populations, Rates and Sample Size Determination.

Total Hours:	**45**

Text Books:

1	Ronald Christensen, Wesley Johnson, Adam Branscum, Timothy E Hanson, “Bayesian Ideas and Data Analysis: An Introduction for Scientists and Statisticians”, CRC Press, 2019.
2	Andrew Gelman, John B, Carlin, Chapman, “Bayesian Data Analysis”, Hall/CRC Publication, 2013.

Reference Books:

1	Gelman, A., Carlin, J. B., Stern, H. S., Rubin, D. B, “Bayesian Data Analysis”, Third Edition, Chapman & Hall/CRC, 2018.

2	Gill, Jeff, “Bayesian Methods: A Social and Behavioral Science Approach”, CRC. 3rd Edition, 2013.
3	Peter D. Hoff, “A First Course in Bayesian Statistical Methods”, Springer, 2009.
Web References:	
1	https://www.coursera.org/learn/bayesian-statistics
2	https://onlinecourses.swayam2.ac.in/imb21_mg03/preview

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C912.1	Understand	Quiz	20
C912.2	Apply	Tutorial	20
C912.3	Apply	Group Assignment	20
C912.4	Understand		
C912.5	Apply	Presentation	20
C912.6	Apply		

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C912.1	3	3	3	2	3	2						2	2	2	2
C912.2	3	3	3	2	3	2						2	2	2	2
C912.3	3	3	3	3	3	2						2	2	2	2
C912.4	3	3	3	2	3	2						2	2	3	3
C912.5	3	3	3	3	3	3						3	3	2	2

21AD913	INFORMATION EXTRACTION AND RETRIEVAL	3/0/0/3

Nature of Course	G (Theory Analytical)
Prerequisites	Data mining

Course Objectives:

1	To outline basic terminology and components in information retrieval.
2	To understand the concepts of IR models.
3	To explore information extraction and integration.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C913.1	Understand the basic concepts in Information Retrieval.	[U]
C913.2	Analyze the searching and indexing techniques.	[A]
C913.3	Understand the link analysis for ranking.	[U]
C913.4	Apply classification and clustering techniques on text documents.	[AP]
C913.5	Evaluate the effectiveness of information retrieval methods.	[E]
C913.6	Able to understand extraction of information and integration.	[U]

Course Contents:

Module I - Introduction **15 Hours**

History, Components of IR – Open-source Search engine Frameworks - The impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Characterizing the web. **Querying:** Pre-processing - wildcard queries, Phrase Queries - Relevance Feedback - Query expansion. **Models:** Boolean and vector-space retrieval models - Term weighting - TF - IDF weighting - cosine similarity –- efficient processing with sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing. **Searching and Indexing:** Web Search Architectures - crawling - meta crawlers - Focused Crawling - Inverted indices - web indexes – Near-duplicate detection - Index Compression – XML retrieval.

Module II - Link Analysis, Classification and Clustering **15 Hours**

Link Analysis: Hubs and Authorities – Page Rank and HITS algorithms- Evaluation- metrics Recall, Precision and F measure – Evaluations on Benchmark Text Collections – Text Representation – Word Statistics – Morphology – Index Term Selection using Thesauri –Metadata and Markup Languages. **Classification-** Text classification and clustering - Categorization algorithms: Naive Bayes; decision trees; and nearest neighbour, Support Vector Machine – **Clustering algorithms:** Flat clustering, Hierarchical Clustering, Agglomerative clustering, K-means, Expectation Maximization (EM) - Semantic Matching using Neural Networks. Recommendation System.

Module III: Information Extraction **15 Hours**

Integration of Information extraction- Entity Extraction-Rule based methods and Statistical methods-Extracting Data from Text – XML – Ontologies, thesauri, semantic web – Collecting and Integrating Specialized Information on the Web - Evaluation of Information extraction Technologies **Case Study:** Organizations and Information systems data in Traditional file Environment, Biomedical Texts and Business Texts.

Total Hours:	**45**

Text Books:

1	Christopher D.Manning, Prabhakar Raghavan,Hinrich Schutze, “Introduction to information retrieval”, Cambridge university press, first south asian edition, 2012.
2	Ricardo Baeza-Yates, Berthier Ribeiro-Neto, “Modern information retrieval: The concepts and technology behind search”,ACM press books, second edition, 2011.
3	Marie Francine Moens, “Information Extraction: Algorithms and Prospectus in a Retrieval Context”, 2010.

Reference Books:

1	Stephen Buettcher, Charles L.A. Clarke and Gordon V. Carmack, “Information Retrieval: Implementing and Evaluating Search Engines”, MIT Press, 2010
2	Bruce Croft, Donald Metzler and Trevor Strohman, “Search Engines: Information Retrieval in Practice”, 1st Edition Addison Wesley, 2009.
3	Mark Levene, “An Introduction to Search Engines and Web Navigation”, 2nd Edition, Wiley, 2010.
Web References:	
1	Information Retrieval,Wiley
2	https://www.coursera.org/courses/information/retrieva
3	https://www.sciencedirect.com/topics/computer-science/information-retrieval-systems
4	https://en.wikipedia.org/wiki/Information_retrieval

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C913.1	Understand	Quiz	20
C913.2	Analyze	Tutorial	20
C913.3	Understand	Group Assignment	20
C913.4	Apply		
C913.5	Apply	Presentation	20
C913.6	Understand		

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C913.1	3	3	3	2	3	2						2	2	2	2
C913.2	3	3	3	2	3	2						2	2	2	2
C913.3	3	3	3	3	3	2						2	2	2	2
C913.4	3	3	3	2	3	2						2	2	3	3
C913.5	3	3	3	3	3	3						3	3	2	2
C913.6	3	3	3	3	3	3					3	3	2	3	3

21AD914	BIOLOGY FOR ENGINEERS	3/0/0/3

Nature of Course	G (Theory Analytical)
Prerequisites	-

Course Objectives:

1	To familiarize the students with the basic organization of organisms and subsequent building to a living being
2	To impart knowledge on molecular biology and nervous systems
3	To provide adequate knowledge on the immune system and cell signalling.
4	To be familiar with the enzymes and their industrial applications

Course Outcomes:

Upon completion of the course, students shall have ability to:

C914.1	Describe biological cell structure and its functions	[U]
C914.2	Explain protein structure and its synthesis	[U]
C914.3	Discuss nervous system and Immune system	[U]
C914.4	Highlight the important functions of enzymes	[AP]
C914.5	Analyze the applications of enzymes in different industrial processes	[A]
C914.6	Analyze the various applications of Pharmaceutical industries	[A]

Course Contents:

Basic cell biology **15 hours**

Introduction: Methods of Science-Living Organisms: Cells and Cell theory, Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell Metabolism-Homoeostasis- Cell growth, reproduction, and differentiation.

Biochemistry, Molecular biology, Nervous and Immune system **15 hours**

Biological Diversity-Chemistry of life: chemical bonds-Biochemistry and Human Biology-Protein synthesis-Stem cells and Tissue engineering, Nervous system-Immune system- General principles of cell signaling.

Enzymes and industrial applications **15 hours**

Enzymes: Biological catalysts, Proteases, Carbonic and hydrase, Restriction enzymes, and Nucleoside monophosphate kinases – Photosynthesis. **Industrial Applications:** Applications of Enzymes in Food processing industries, Pharmaceutical industries, textile processing and fabric finishing industries.

Total Hours:	**45**

Text Books:

1	S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S. Barathi, and M. K. Jaganathan, “Biology for Engineers,” Tata McGraw-Hill, New Delhi, 2012.
2	Wiley Editorial team,” Biology for Engineers: As per Latest AICTE Curriculum, Wiley Precise Text book Series, New Delhi- Jan 2018.

Reference Books:

1	Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, “Biochemistry,” W.H. Freeman and Co. Ltd., 6thEd., 2006.
2	Robert Weaver, “Molecular Biology,” MCGraw-Hill, 5thEdition, 2012.
3	Kenneth Murphy, “Janeway's Immunobiology,” Garland Science; 8th edition, 2011.
4	Eric R. Kandel, James H. Schwartz, Thomas M. Jessell, “Principles of Neural Science, McGraw-Hill, 5th Edition, 2012.
5	Arthur T. Johnson,”Biology for Engineers”,CRC Press, Taylor and Francis, 2019

Web References:

1	https://ocw.mit.edu/courses/biology/7-06-cell-biology-spring-2007/

2	https://www.coursera.org/lecture/industrial-biotech/biocatalysis-and-enzymatic-processes-qruF0

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C914.1	Understand	Quiz	20
C914.2	Understand	Tutorial	20
C914.3	Understand	Group Assignment	20
C914.4	Apply		
C914.5	Analyze	Presentation	20
C914.6			

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C914.1	3	3	3	2	3	2						2	2	2	2
C914.2	3	3	3	2	3	2						2	2	2	2
C914.3	3	3	3	3	3	2						2	2	2	2
C914.4	3	3	3	2	3	2						2	2	3	3
C914.5	3	3	3	3	3	3						3	3	2	2
C914.6	3	3	3	3	3	3					3	3	2	3	3

21AD915	WEB AND SOCIAL MEDIA MINING	3/0/0/3
Nature of Course	H (Theory Technology)	
Pre requisites	Data Warehousing and Mining	

Course Objectives:

1	To provide an overview of common text mining and social media data analytic activities.
2	To introduce the various tools for Text Mining and carry out Pattern Discovery, Predictive Modeling.
3	To understand the complexities of processing text and network data from different data sources.
4	To enable students to solve complex real-world problems for sentiment analysis and Recommendation systems.

Course Outcomes:
Upon completion of the course, students shall have ability to

C915.1	Interpret the terminologies, metaphors and perspectives of social media analytics.	[U]
C915.2	Apply a wide range of classification, clustering, estimation and prediction algorithms on Textual data.	[AP]
C915.3	Perform social network analysis to identify important social actors, subgroups and network properties in social media sites.	[A]
C915.4	Provide solutions to the emerging problems with social media such as behavior analytics and recommendation systems.	[A]
C915.5	Design new solutions to opinion extraction, sentiment classification and data summarization problems.	[AP]

Course Contents:

Module 1: Text and Web Mining: **18 Hours**

Text Representation- tokenization, stemming, stop words, TF-IDF, Feature Vector Representation, NER, Text Clustering, Text Classification, Topic Modeling, Query optimization, page ranking. Web Crawling-Crawler Algorithms, Implementation Issues, Evaluation, Session & visitor Analysis, Visitor Segmentation, Analysis of Sequential & Navigational Patterns, Predictions based on web user transactions.

Module 2: Social Media Mining **15 Hours**

Social network and web data and methods. Graphs and Matrices. Basic measures for individuals and networks. Information visualization. **Making connections**: Link analysis. Random graphs and network evolution. **Social contexts**: Affiliation and identity; Social network analysis, Recommendation system

Module 3: Sentimental and Behavioral Analytics **12 Hours**

Content Analysis; Natural Language Processing; Clustering & Topic Detection; Simple Predictive Modeling; Sentiment Analysis; Sentiment Prediction. **Behavior Analytics**: Individual Behavior, Collective Behavior. **Case study:** Usage of Linguistic Inquiry and Word Count (LIWC) analysis software program and similar tools.

Total Hours: 45

Text Books:

1.	Matthew A. Russell, Mikhail Klassen “Mining the Social Web”, Third Edition, 2019.
2.	Bing Liu, “Web Data Mining-Exploring Hyperlinks, Contents, and Usage Data”, Springer, Second Edition, 2011.
3.	Reza Zafarani, Mohammad Ali Abbasi and Huan Liu, “Social Media Mining – An Introduction”, Cambridge University Press, 2014.

Reference Books:

1.	Bing Liu, “Sentiment Analysis and Opinion Mining”, Morgan & Claypool Publishers, 2012.
2.	Nitin Indurkhya, Fred J Damerau, “Handbook of Natural Language Process”, 2nd Edition, CRC Press, 2010.
3.	Matthew A.Russell, “Mining the social web”, 2nd edition- O'Reilly Media, 2013.
4.	Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, First Edition, 2009.

Web References:	
1.	https://www.g2.com/articles/social-media-data-mining
2.	www.gsb.stanford.edu/faculty-research/behavioral-lab
Online Resources:	
1.	https://www.coursera.org/projects/basic-sentiment-analysis-tensorflow
2.	https://cs.ccsu.edu/~markov/ccsu_courses/WebMining.html
3	https://www.coursera.org/learn/text-mining?specialization=data-mining

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C915.1	Understand	Quiz	20
C915.2	Apply	Tutorial	20
C915.3	Apply	Group Assignment	20
C915.4	Understand		
C915.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

* SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
* FA1 & FA 2 is internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
* ES exams conducted and evaluated for 100 marks.

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C915.1	3	3	3	2	2	2		2	2	2	2	2			
C915.2	3	3	3	3	3	3		2	2	2	2	3			
C915.3	3	3	3	3	3	3		2	3	2	2	3			
C915.4	3	3	3	3	3	3		2	3	3	2	3			
C915.5	3	3	3	3	3	3		2	3	3	2	3			

21AD916	INTRODUCTION TO BRAIN AND NEUROSCIENCE	3/0/0/3
Nature of Course:	F (Theory)	
Pre requisites:	Nil	

Course Objectives:

1	To provide students with broad knowledge of the field of neuroscience.
2	To synthesize knowledge of the discipline of neuroscience.
3	Demonstrate a broad foundation in the concepts and methodologies of the interdisciplinary field of neuroscience.
4	To describe the functions of the brain and contribution of the nervous system.

Course Outcomes:
Upon completion of the course, students shall have ability to

C916.1	Understand the function of the Nervous system at various levels.	[U]
C916.2	Analyze neuroscience nature and computation.	[A]
C916.3	Interpret and report nervous system techniques.	[U]
C916.4	Understand role of neural activity in development	[U]
C916.5	Analyze the brain at the behavioral level of analysis.	[A]
C916.6	Apply and integrate to other areas of study.	[AP]

Course Contents:

Module I **15 hours**

Introduction to neuroscience – Cells of the Nervous system - Building a Brain: Development - Organization of the Nervous System - The senses - Outline of neuroanatomy – Role of experiments and computation in neuroscience; Methods in neuroscience; The interdisciplinary nature of neuroscience - Cognitive neuroscience.

Module II **15 hours**

Neural Systems: Organization of the vertebrate brain - Development of the Nervous system Neurogenesis, migration, Axon pathfinding ,Role of neural activity in development –eye-hearing olfaction.

Module III **15 hours**

Brain and behavior: Brain – Organization of the brain and its function - Behavior and cognition; Systems : Motor, sensory and learning; Regions; Networks; Neuron; Ion channels. **Case Study:** Medical Diagnosis.

	Total Hours: 45
Text Books:	
1.	Johns Hopkins,UPen, “Neuroscience”, MIT, Fourth Edition, 2015.
2.	Bob Garrett, Gerald Hough, “Brain and Behavior: An introduction to Behavioral Neuroscience”, Fifth Edition, 2017.
Reference Books:	
1.	Eric R Kandel, James H Schwartz, “Principles of Neural Science”, Stanford, UCSF, Columbia, 2018.
2.	Charles A Nelson, “Brain, Mind and Behavior”, Macmillan Learning, 2006.
Web References:	
1.	https://en.wikipedia.org/wiki/Neuroscience
2	https://en.wiktionary.org/wiki/neurosystem
3	https://psychology.fas.harvard.edu/cognition-brain-behavior
Online Resources:	
1	https://onlinelibrary.wiley.com/journal/21579032
2	https://open.bu.edu/handle/2144/27397

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C916.1	Understand	Quiz	20

C916.2	Analyze	Tutorial	20
C916.3& C916.4	Understand	Group Assignment	20
C916.5	Analyze		
C916.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C916.1	3	3										2			2
C916.2	2	2	3									2			2
C916.3	2	3	2									2			2
C916.4	2	3	3									3			2
C916.5	3	2	3									3			3
C916.6	3	2										3			3

21AD921	ETHICAL HACKING	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Nil	
Course Objectives:		
1	To understand the basic concepts of ethical hacking.	
2	To know about legal consideration while using ethical hacking.	
3	To understand the surveying the attack surface.	
4	To outline the design of active host.	
5	To discuss about network mapping technology.	
Course Outcomes: Upon completion of the course, students shall have ability to:		
C921.1	Understand the requirements of ethical hacking.	[U]
C921.2	Know the usage of threat agent and risk.	[R]
C921.3	Discover the various manipulations on surveying attack.	[AP]
C921.4	Interpret the real world active reconnaissance.	[AP]
C921.5	Analyze the working of active host.	[A]

Course Contents:

Module I: Introduction to Ethical Hacking **15 Hours**

Introduction to Ethical Hacking - Confidentiality, Integrity and availability in Ethical Hacking - Legal Considerations – Threat – Threat Agent – Vulnerability – Flaw – Issue – exploit – Attack – Risk -Incident

Module II: Reconnaissance - Surveying the Attack Surface **15 Hours**

Introduction to Reconnaissance - Surveying the attack surface - passive reconnaissance - active reconnaissance – Information collection using Reconnaissance. **Case study** on Reconnaissance.

Module III: Scanning and Enumeration **15 Hours**

Introduction to Scanning and enumeration - Introduction to Active host – Identifying active host - Network Mapping-Introduction to Nmap and its utilities. **Case study** on Nmap

Total Hours:	**45**

Text Books:	
1	ETHICAL HACKING: A Comprehensive Beginner's Guide to Learn and Master Ethical Hacking Kindle Edition by HEIN SMITH (Author), HILARY MORRISON (Author) Format: Kindle Edition
2	Nmap Network Exploration and Security Auditing Cookbook: Network discovery and security scanning at your fingertips, 3rd Edition 3rd ed. Edition by Paulino Calderon (Author)
Reference Books:	
1	Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning, 2010.
2	Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning, 2009-11-01.
3	Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series – Elsevier, August 4, 2011.

4	Whitaker & Newman, " Penetration Testing and Network Defense" , Cisco Press, Indianapolis, IN, 2006.
Web References:	
1	https://www.coursera.org/learn/ethical-hacking-essentials-ehe
2	https://www.javatpoint.com/ethical-hacking
3	https://www.udemy.com/topic/ethical-hacking/
4	https://www.geeksforgeeks.org/introduction-to-ethical-hacking/

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C921.1	Understand	Quiz	20
C921.2	Analyze	Tutorial	20
C921.3	Understand	Group Assignment	20
C921.4	Analyze		
C921.5	Understand	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C921.1	2			1						1			3	1	
C921.2	2	1	1	1						1	1		2	2	
C921.3	2	1	1	1						1	1		1	2	
C921.4	2	1	1	1						2	2		2	1	
C921.5	2	1	1	1						1	1		1	1	

21AD922	ETHICAL HACKING AND AUDITING FRAMEWORKS	3/0/0/3
Nature of Course	F (Theory Programming)	
Course Objectives:		
1	Introduce Student to learn technical foundation of cracking and ethical hacking	
2	Aspects of security, importance of data gathering, foot printing and system hacking	
3	evaluation of computer security	
4	Practical tasks will be used to re-enforce and apply theory to encourage an analytical and problem-based approach to ethical hacking	
5	Identify various social engineering concepts & Forensic tools and techniques	
Course Outcomes: Upon completion of the course, students shall have ability to:		
C922.1	Learn various hacking methods.	[U]
C922.2	Perform system security vulnerability testing.	[AP]
C922.3	Perform system vulnerability exploit attack	[AP]
C922.4	Produce a security assessment report	[AP]
C922.5	Learn various Social engineering concepts & Forensic tools and techniques	[U]

Course Contents:

Hacking Windows **15 Hours**

BIOS Passwords, Windows Login Passwords, Changing Windows Visuals, Cleaning Your Tracks, Internet Explorer Users, Cookies, URL Address Bar, Netscape Communicator, Cookies, URL History, The Registry, Baby Sitter Programs. Case Study: Healthcare System Security Assessment

Advanced Windows Hacking **15 Hours**

Editing your Operating Systems by editing Explorer.exe, The Registry, The Registry Editor, Description of .reg file, Command Line Registry Arguments, Other System Files, Some Windows & DOS Tricks, Customize DOS, Clearing the CMOS without opening your PC, The Untold Windows Tips and Tricks Manual, Exiting Windows the Cool and Quick Way, Ban Shutdowns: A Trick to Play, Disabling Display of Drives in My Computer, Take Over the Screen Saver, Pop a Banner each time Windows Boots, Change the Default Locations, Secure your Desktop Icons and Settings. Case Study: Financial Institution Penetration Test

Auditing Frameworks **15 Hours**

Social Engineering, Social engineering concepts, Phishing attacks and counter measures, Pretexting, baiting, and quid pro quo, Social engineering awareness and prevention, Incident response process, Digital forensics fundamentals, Forensic tools and techniques ,Chain of custody and legal considerations - Real-world penetration testing scenario, Application of knowledge and skills, Presentation and documentation of findings Case Study: Securing E-Commerce Platform

	Total Hours:	**45**

Text Books:

1	Patrick Engbreston: “The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy”3rd Edition, Syngress publication,2022.
2	Ankit Fadia : “Unofficial Guide to Ethical Hacking”, 5th Edition , McMillan India Ltd,2021.
3	Mike Kegerreis , Mike Schiller , Chris Davis , IT Auditing Using Controls to Protect Information Assets, Third Edition (NETWORKING & COMM - OMG), McGraw-Hill,2021

Reference Books:

1	Simpson,backman, corley, “HandsOn Ethical Hacking & Network Defense International”, 2nd Edition,Cengageint,2022.

2	Aamer Khan " Ethical Hacking 2022 - BLACK BOOK" Paperback – 1 January 2022
Web References:	
1	https://archive.nptel.ac.in/courses/106/105/106105217/
2	http://www.nitttrc.edu.in/nptel/courses/video/106105217/L39.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C922.1, C922.5	Understand	Assignment Quiz	20 20
C922.2, C922.3, C922.4	Apply	Case Study Presentation	20 20
Assessment based on Summative and End Semester Examination			
Revised Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	30	20	20
Understand	30	30	20
Apply	20	50	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C922.1	3	3	3	2	3	2						2	2	2	2
C922.2	3	3	3	2	3	2						2	2	2	2
C922.3	3	3	3	3	3	2						2	2	2	2
C922.4	3	3	3	2	3	2						2	2	3	3
C922.5	3	3	3	3	3	3						3	3	2	2

21IT921	CYBER SECURITY	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Nil	
Course Objectives:		
1.	To understand the fundamental concepts of cyber security.	
2.	To learn various security techniques and attacks.	
3.	To learn about processor design.	
4.	To handle files and directory permissions.	
5.	To design various security policies.	
Course Outcomes		
Upon completion of the course, students shall have ability to		
C921.1	Understand cyber security and applications.	[U]
C921.2	Apply various techniques to protect system from security attacks.	[AP]
C921.3	Examine the Linux commands	[R]
C921.4	Apply various file handling techniques in real time applications.	[AP]
C921.5	Understand the basics of HTTP, SSL, TLS, DES	[U]
C921.6	Infer suitable security policies for the given requirements.	[A]

Course Contents:

Introduction to Cyber Security: 15 Hours

Introduction to cyber-Security –History of cyber security- Benefits of cyber security-Applications of Cyber security -backup and Data Recovery-Physical access control-Logical access controls - Securely Configured and Encrypted Devices- Securely Configured Network Components- Network segmentation- Email and Online Protection- Wireless Security-Wireless Security-Maintenance monitoring and patching- Vulnerability Assessments and Security Training

Processor Design and Advanced Linux 15 Hours

Changing Directory & Navigation, listing files, Copy, Move, Remove files, Vim, Nano, User Commands, Group Commands, Network Display Commands, Network Configuration Commands, Network Address Spoofing, Handling Files and Directory permissions

Security Protocols: 15 Hours

HTTP, HTTPS, SSL, TLS, Symmetric Key Ciphers: Simplified DES – Block cipher Principles of DES – Strength of DES –Block cipher design principles – Block cipher mode of operation - prime and relatively prime numbers – Testing for primality – Factorization – Euler ‘s totient function, Fermat ‘s and Euler ‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - Asymmetric Key Ciphers: RSA cryptosystem – Key management – Diffie Hellman key exchange.

	Total Hours	**45**

Text Books:	
1.	Charles J. Brooks, Christopher Grow, Philip Craig, “Cybersecurity Essentials Paperback – Illustrated”, Sybex Publisher, 2018.
2.	William Stallings, “Cryptography and Network Security - Principles and Practice” 7th Edition, Pearson Publishers, 2017.

3.	James Graham, Richard Howard and Ryan Olson, "Cyber Security Essentials", Auerbach Publications, USA, 2017.
Reference Books:	
1.	Ben Smith and Brain Komer, “Microsoft Windows Security Resource Kit” Prentice Hall of India, 2010.
2.	Ankit Fadia and Manu Zacharia, "Network Intrusion Alert: An Ethical Hacking Guide to Intrusion Detection", Thomson Course Technology, USA, 2010.
3.	George K. Kostopoulous, “Cyber Space and Cyber Security”, CRC Press, 2017.
4.	Martti Lehto, Pekka Neittaanmaki, “Cyber Security: Analytics, Technology and Automation”, Springer International Publishing Switzerland, 2015.
Web References:	
1.	https://en.wikipedia.org/wiki/Colonial_Pipeline_ransomware_attack
2.	https://en.wikipedia.org/wiki/Ukraine_power_grid_hack
3.	https://gdpr-info.eu/
4.	https://www.isms.online/information-security-management-system-isms/
Online Resources:	
1.	https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
2.	https://www.edx.org/course/cybersecurity-fundamentals
3.	https://www.coursera.org/specializations/intro-cyber-security
4.	https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	t**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C921.1	Understand	Quiz	20
C921.2	Apply		
C921.3	Remember	Assignment	20
C921.4	Apply		
C921.5	Understand	Assignment	20
C921.6	Analyse	Case Study	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	35	35	35
Apply	25	25	25
Analyse	20	20	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C921.1	2	3	3	3	-	-	-	-	-	-	-	3	2	2	2
C921.2	2	3	3	3	-	-	-	-	-	-	-	3	2	1	2
C921.3	3	2	2	2	-	-	-	-	-	-	-	-	2	2	2
C921.4	3	2	2	3	-	-	-	-	-	-	-	2	2	2	2
C921.5	3	3	3	3	-	-	-	-	-	-	-	2	2	2	1
C921.6	3	3	3	3	-	-	-	-	-	-	-	2	2	2	1

21AD923	IMAGE SIGNAL PROCESSING	3/0/0/3
Nature of Course	G (Theory & Analytical)	
Pre-Requisite	Fundamentals of Signals and Systems	

Course Objectives:

1	To make students understand Discrete Fourier Transform techniques and basic multi-rate signal processing.
2	Understand the fundamentals of digital imaging.
3	To be apply to apply basic image processing techniques like enhancement, segmentation, morphological etc.
4	To learn and apply image compression techniques.

Course Outcomes:
Upon completion of the course, students shall have ability to

C923.1	Understand Discrete Fourier Transform techniques to evaluate	[U]
C923.2	To apply multi-rate signal processing techniques like decimation & interpolation.	[AP]
C923.3	Understand the fundamentals of digital imaging.	[U]
C923.4	To be able to apply image enhancement techniques to images in both spatial & frequency domain.	[AP]
C923.5	Apply segmentation, morphological processing techniques to input images.	[AP]
C923.6	To understand & analyze image compression techniques and models.	[AN]

Course Contents:

Module I Digital Signal Processing: 15 Hours

Computation of DFT, Properties of DFT, Circular convolution, Fast Fourier Transforms (FFT) algorithms – Decimation in Time algorithm, Decimation in Frequency algorithms, DFTs in linear filtering – overlap add & overlap save methods. Multirate DSP – Decimation, Interpolation.Case Study -

Module II Digital Image Fundamentals & Image Enhancement 15 Hours

Fundamental steps, Components of image processing system, Elements of visual perception, Image sampling & quantization, Basic relationships between pixels, Image Enhancement: Spatial Domain: Basic intensity transformation functions, Histogram processing, Spatial Filtering–Smoothing and Sharpening Spatial Filters, Frequency Domain: Introduction to Fourier Transform, Frequency domain filtering - Smoothing and Sharpening frequency domain filters, Homomorphic filtering.

Module III Digital Image Segmentation, Morphological Processing & Compression 15Hours

Image Segmentation - Segmentation concepts, point, line and Edge detection, Thresholding, Region based segmentation. Morphological image processing - Erosion & dilation, Opening & closing, Image Compression models: Lossy and Lossless, Huffmann coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive coding, JPEG, MPEG standards.

Total Hours: 45

Text Books:

1	John G. Proakis& Dimitris G. Manolakis, “Digital Signal Processing”, Pearson, 4th edition, 2019.
2	Rafael C. González ,Richard E Woods, “Digital image processing” Pearson Education,Third Edition, 2014.

Reference Books:

1	W. K. Pratt, “Digital Image Processing”, John Wiley and Sons, Second Edition, 2008.
2	Sanjit K. Mitra, “Digital Signal Processing: A Computer-Based Approach”, The McGraw-Hill Education, 4th Edition, 2013.
Web References:	
1	https://www.tutorialspoint.com//digital signal processing/index.htm
2	http://web.stanford.edu/class/ee368/handouts.html
3	http://www.ee.columbia.edu/~sfchang/course/dip/
Online Resources:	
1	nptel.ac.in/downloads/117104020/
2	https://www.edx.org/course/computer-vision-image-analysis-1
3	https://ocw.mit.edu/resources/res-6-008-digital-signal-processing

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C923.1, C923.2	Apply	Tutorial	20
C923.3	Understand	Assignment	20
C923.4, C923.5	Apply	Case Study	20
C923.6	Understand	Quiz	20
Assessment based on Summative and End Semester Examination			
Revised Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	30	20	20
Understand	30	30	20
Apply	20	50	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination

Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks		**CA 2 : 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C923.1		1	1	1	2								3	2	3
C923.2		1	1	1	2								3	2	3
C923.3	1	3	3	3	2								3	3	3
C923.4	1	3	3	3	3								3	3	3
C923.5		2	2	2	2								3	3	3
C923.6	1	3	3	3	3				1		1	2	3	3	3

21AD924	COMPUTATIONAL STATISTICS FOR DATA SCIENCE	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Python for Data Science	
Course Objectives:		
1	To introduce computational statistics concepts.	
2	To study the basics of probability and statistical model.	
3	To determine which type of sampling distribution would be suitable for a given type of application problem.	
4	To design and create small real time applications using statistical model.	
Course Outcomes: Upon completion of the course, students shall have ability to:		
C924.1	Understand the basic computational statistics.	[U]
C924.2	Understand the concepts of exploratory data analysis.	[U]
C924.3	Describe the attributes of sampling distributions that can be applied over data.	[A]
C924.4	Create Rules for multi variable distribution.	[AP]
C924.5	Apply knowledge to design solutions to different problems.	[AP]

Course Contents:

MODULE I EXPLORATORY DATA ANALYSIS **15 Hours**

Elements of structured data – Rectangular Data – Estimates of Location – Estimates of variability – Exploring the data distribution – Exploring Binary and Categorical Data – Exploring two or more variables. Case Study: Analysis of E-commerce Sales Data.

MODULE II DATA AND SAMPLING DISTRIBUTIONS **15 Hours**

Random sampling and sample bias – selection bias – sampling distribution of a statistic – The bootstrap – Confidence intervals – Normal distribution – Long tailed distribution – Binomial distribution – Poisson distribution – Graphical Neural Network. Case Study: Analyzing Election Polling Data Using Sampling and Distribution Techniques.

MODULE III BAYESIAN MODELLING AND APPLICATIONS **15 Hours**

Bayesian Statistics – Markov Chain Monte Carlo Methods for Bayesian modeling – PyMC3 for Bayesian Modeling and Inference – Applications of Statistical Models – **Case Study:** Hybrid Feature Vector-Assisted Action Representation for Human Action Recognition Using Support Vector Machines, Use PyMC3 to model the disease dynamics of and infer the parameters of an SIR model of COVID-19 from real-world data. Case Study: Modeling COVID-19 Dynamics with PyMC3.

Total Hours:	**45**

Text Books:	
1	Hao Helen Zhang, Richard A. Levine, Thomas C. M. Lee, Walter W. Piegorsch, “Computational Statistics in Data Science”, Wiley, March 2022.
2	Peter C.Bruce and Andrew C.Bruce, “Statistics for Data Scientists”, O’Reilly, 2018.
3	Geof H. Givens and Jennifer A. Hoeting,” Computational Statistics” Second Edition, Wiley Publications, 2018.
Reference Books:	
1	Debabrata Samanta, Raghavendra Rao Althar, Sabyasachi Pramanik, Soumi Dutta, “Methodologies and Applications of Computational Statistics for Machine Intelligence”, IGI Global, 2021.
2	Dawn Griffiths, “Head First Statistics: A Brain-Friendly Guide”, O’Reilly, 2018.
3	Christian Heumann, Michel Schomaker, “Introduction to statistics and Data Analysis”, Springer Publishers, 2020.
Web References:	

1	https://www.coursera.org/specializations/compstats
2	https://www.stat.colostate.edu/computationalstatistics/
3	https://www.analyticssteps.com/blogs/introduction-graph-neural-network-gnn

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C924.1	Understand	Quiz	20
C924.2	Remember	Tutorial	20
C924.3	Apply	Assignment	20
C924.4	Apply		
C924.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C924.1	3	3	2	2	3	3	3	3			2	2	3	3	3
C924.2	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3
C924.3	3	3	3	3	2	2	2	3			2	3	3	3	2
C924.4	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C924.5	3	3	3	3	2	2	2	3	2	3	2	2	3	3	3

21AD925	ETHICS IN DATA SCIENCE	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Data Science	
Course Objectives:		
1	To understand the need of ethics in data science.	
2	To know about privacy and their risk.	
3	To be familiar with choice of attributes.	
4	Interpret and apply a professional code of ethics relevant to the data science profession.	
5	To identify ethics in real time with the help of case studies.	
Course Outcomes: Upon completion of the course, students shall have ability to		
C925.1	Identify and analyze the ethical needs in data science.	[U]
C925.2	Articulate the privacy degree and risk.	[U]
C925.3	Apply ethical frameworks to help them analyze ethical challenges.	[AP]
C925.4	Analyze the errors in processing the data and design.	[A]
C925.5	Develop the data based on guiding principles.	[AP]
C925.6	Examine ethics in various real time examples.	[A]

Course Contents:

MODULE I Introduction to Ethics and Data Privacy

Ethics – Data Science needs ethics – Five C's - Informed Consent – Limitations in informed Consent - Privacy – History of Privacy – Degree of Privacy – Modern Privacy risk - Policy guidelines. Case Study: Social Sciences and Behavioural Case.

MODULE II Significance of Ethics

Algorithmic Bias –Policy Guidelines - Ethical Rules- Ethical Frameworks - Ethical Challenges – Best Practices for practitioners and users - Data Validity – Choice of attribute and measure – Errors in Data Processing – Errors in Model Design. Case Study: Algorithmic Bias, Ethical Guidelines, and Data Validity

MODULE III Building Ethics

Code of Ethics – Wrap up – Ethics and security training – Developing guiding principles – Building ethics into data driven culture – Regulation – Case Study: Algorithm Fairness, Social Credit Scores, Target Ads.

Total Hours:	**45**

Text Books:	
1	Bill Franks, "97 Things About Ethics Everyone in Data Science Should Know", O'Reilly Media, Inc, August 2022.
2	Mike Loukides, Hilary Mason, Dj Patil, "Ethics in Data Science", O'Reilly Media, Inc, 2020.
Reference Books:	
1	Shannon Vallor, William J. Rewak, S.J., "An Introduction to Data Ethics", Santa Clara University, 2021.
2	John D. Kelleher, Brendan Tierney, "Data Science", MIT Press, 2020.
Web References:	
1	https://www.coursera.org/learn/data-science-ethics

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component**	**FA (16%) [80 Marks]**
C925.1, C925.2	Apply	Tutorial	20
C925.3	Understand	Assignment	20
C925.4, C925.5	Apply	Case Study	20
C925.6	Understand	Quiz	20
Assessment based on Summative and End Semester Examination			
Revised Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	30	20	20
Understand	30	30	20
Apply	20	50	40
Analyse	20	-	20
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C925.1	3	3	2	2	3	3	3	3			2	2	3	3	3
C925.2	3	3	2	2	3	3	3	3	1	1	2	2	2	3	3
C925.3	3	3	3	3	2	2	2	3			2	3	3	3	2
C925.4	3	3	2	2	3	3	3	3	1	1	2	2	3	2	2
C925.5	3	3	3	3	2	2	2	3	2	3	2	2	3	3	3

21AD926	BUSINESS INTELLIGENCE	3/0/0/3
Nature of Course	C (Theory Concept)	
Prerequisites	Nil	

Course Objectives:

1	To learn the fundamentals of business intelligence.
2	To acquire knowledge in data integration.
3	To perform multi-dimensional data modelling.
4	To explore enterprise reporting.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C926.1	Recognize the needs of Business Intelligence.	[R]
C926.2	Understand the technology and processes associated with Business Intelligence Framework.	[U]
C926.3	Understanding the Data Warehouse implementation methodology, metrics to achieve business goal.	[U]
C926.4	Design an enterprise dashboard that depicts the key performance indicators which helps in decision making.	[AP]
C926.5	Analyze SQL Server Reporting Services (SSRS) architecture, including its components and their roles in generating, managing and delivering reports within an enterprise environment.	[A]

Course Contents:

MODULE I Introduction to Business Intelligence **15 hours**

Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components - BI Process, BI Technology, BI Roles & Responsibilities. Case Study: Retail for Enhanced Decision-Making

MODULE II Introduction to Data Integration and Multi-Dimensional Data Modeling **15 hours**

Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, introduction to Extraction Transformation Loading (ETL) using SSIS, Introduction to data quality, data profiling concepts and applications. Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi-dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using SSAS. Case Study: Improving Retail Performance through Data Integration and Business Intelligence.

MODULE III Basics of Enterprise Reporting **15 hours**

Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, introduction to SSRS Architecture, enterprise reporting using SSRS**. Case Study:** A Comparative study of KPI dashboard tools, Enterprise Reporting Enhancement using SSRS

Total Hours:	**45**

Text Books:

1	Rajiv Sabherwal, Irma Becerra-Fernandez, “Business Intelligence Practices, Technologies, and Management”, Wiley, 2013.
2	Cindi Howson, “Successful Business Intelligence”, McGraw-Hill Education, 2nd edition, 2013.
3	David Loshin, “Business Intelligence”, Morgan Kaufmann, 2nd Edition, 2012.
4	Mike Biere, “Business intelligence for the enterprise”, Prentice Hall Professional, 2003.
5	R.N.Prasad, SeemaAcharya, “Fundamentals of Business Analytics”, John Wiley & Sons, 2011.,

Reference Books:

1	Larissa Terpeluk Moss, ShakuAtre, “Business intelligence roadmap”, Addison-Wesley Professional, 2003.
2	Cindi Howson, “Successful Business Intelligence: Secrets to making Killer BI Applications”, McGraw Hill Professional, 2013.
3	Brain Larson, “Delivering business intelligence with Microsoft SQL server”, 2008, McGraw Hill Professional, 2016.
4	Lynn Langit, “Foundations of SQL Server 2005 Business Intelligence”, Apress, 2007.
5	Stephen Few, Information dashboard design, O’Reilly, 2006.
6	Efraim Turban, Ramesh Sharda, DursunDelen, “Decision Support and Business Intelligence Systems”, 10th Edition, Pearson 2014.
Web References:	
1	https://www.wipro.com/documents/resource-center/library/bidw_bilogistics.pdf
2	https://en.wikipedia.org/wiki/Business_intelligence
3	https://www.webopedia.com/
4	campusconnect.infosys.com/homedownloads/BI/Dashboard
Online Resources:	
1	https://www.coursera.org/learn/business-intelligence-tools
2	https://www.coursera.org/courses?query=business%20intelligence
3	https://www.coursera.org/specializations/data-warehousing

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C926.1	Understand	Quiz	20
C926.2	Remember	Tutorial	20
C926.3	Apply	Assignment	20
C926.4	Apply		
C926.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20

Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C926.1	3	3	3	2	2	2	2	2	2	2	2	2	3	3	3
C926.2	3	3	3	3	3	3	2	2	2	2	3	3	3	3	3
C926.3	3	3	3	3	3	3	2	3	2	2	3	2	2	2	3
C926.4	3	3	3	3	3	3	2	3	3	2	3	3	3	3	3
C926.5	3	3	3	3	3	3	2	3	2	2	3	2	2	2	3

21AD927	INTELLIGENT MULTI AGENT AND EXPERT SYSTEMS	3/0/0/3
Nature of Course	F (Theory Programming)	
Prerequisites	Artificial Intelligence Principles and Techniques	
Course Objectives:		
1	To understand the technicalities of Multi - agents.	
2	To understand techniques of computing solutions on various forms of games.	
3	To learn sequential action games and representations.	
4	To gain the knowledge on relating AI and expert systems.	
5	To learn the basics on expert system tools.	
Course Outcomes: Upon completion of the course, students shall have ability to:		
C927.1	Classify different types of multi-agent systems.	[A]
C927.2	Apply the agent concept in a distributed computing game environment.	[AP]
C927.3	Design and use appropriate representation scaling for agent communication.	[AP]
C927.4	Understands the conceptual and technical foundation of expert systems.	[U]
C927.5	Build complex computational and socio-technical systems using expert systems.	[AP]

Course Contents:

MODULE I INTRODUCTION **15 hours**

Multiagent Systems and Distributed AI - Characteristics of Multiagent Systems- Applications - Applications - Rational Agent: Agents as Rational Decision Makers - Observable Worlds and the Markov Property - Observable Worlds and the Markov Property - Partial Observability - Self-Interested Agents-Mechanism Design Problem. Case Study: Autonomous Vehicles

MODULE II AGENT ARCHITECTURE AND COMMUNICATION **15 hours**

Intelligent Agent - Multiagent organization-Agent Communication - Negotiation and Bargaining - Trust and Reputation in multiagent systems - Distributed cognitive abilities - programming multiagent system-specification and verification - Logics for multiagent. Case Study: Real-time Traffic Management System.

MODULE III EXPERT SYSTEMS AND TOOLS **15 hours**

Expert systems and AI – Production rules and interface: Knowledge representation – Interference in production systems – Pattern recognition and production rules – Tools for knowledge and interference inspection: User interface and explanation – User interface in PROLOG – Rule models. Case Study: Medical Diagnosis Expert System.

Total Hours:	**45**

Text Books:	
1	Multi Agent Systems Technologies and Applications Towards Human – Centered, Indradip Banerjee, Shibakali Gupta, Siddhartha Bhattacharyya, Springer Nature Singapore, 2022.
2	A Concise Introduction to Multiagent Systems and Distributed Artificial Intelligence,Nikos Vlassis,Morgan & Claypool Publishers, 2007.
3	Multiagent Systems,By Maria Alpers, Herbert Voges, Gerhard,MIT PRESS, 2016
4	Principles of Expert Systems, Peter J.F. Lucas & Linda C. van der Gaag, 2017.
Reference Books:	

2	Expert Systems: Principles and Programming with CD By Joseph C. Giarratano, 2019.
3	Multiagent Systems Algorithmic, Game-Theoretic, and Logical Foundations By Yoav Shoham, Kevin Leyton-Brown, 2009.
Web References:	
1	https://www.turing.ac.uk/research/interest-groups/multi-agent-systems
2	https://www.ias.ac.in/article/fulltext/reso/003/03/0, 046-0058

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C927.1	Understand	Quiz	20
C927.2	Remember	Tutorial	20
C927.3	Apply	Assignment	20
C927.4	Apply		
C927.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination				
Continuous Assessment (40%) [200 Marks]				**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks		**CA 2: 100 Marks**		
SA 1	**FA 1 (40 Marks)**	**SA 2**	**FA 2 (40 Marks)**	

(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	(60 Marks)	Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C927.1	2	2	2	1	1							2	2	2	2
C927.2	3	2	2	3	2							2	2	2	2
C927.3	3	2	2	2	1							2	2	2	2
C927.4	2	2	2	2	2							2	2	3	3
C927.5	3	3	2	2	1							3	3	2	2

21AD001	FUNDAMENTALS OF DATABASE SYSTEMS	3/0/0/3

Nature of Course	G (Theory Analytical)
Pre requisites	Nil

Course Objectives:

1	To discuss the fundamentals of data models to conceptualize and depict a database system using ER diagrams.
2	To illustrate the relational database implementation using SQL with effective relational database design concepts.
3	To employ the normalization concepts to improve the database design.
4	To explain the fundamental concepts of transaction processing concurrency control techniques and Database Security.
5	To introduce the concepts of other Databases and NoSQL.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C001.1	Distinguish database systems from file systems and describe data models and DBMS architecture.	[U]
C001.2	Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.	[AP]
C001.3	Apply different normal forms to retrieve the data efficiently by removing Anomalies.	[AP]
C001.4	Infer the basic database storage structures and access techniques.	[A]
C001.5	Examine the concepts of Transaction processing, concurrency locking protocols.	[A]

Course Contents:

MODULE I DATA MODELS AND SQL **15 Hours**

Introduction to Database – File System Vs Database system – Users - Data models: Hierarchical - Network - Object Oriented - Entity Relationship – Relational Data Models - Database System Architecture - Data Abstraction - Data Independence - Integrity Constraints - Concept of Relations - Schema-Instance distinction - Table and key definitions – Views - Relational Query Languages: DDL – DML – TCL - DCL – SQL - Embedded SQL - Introduction to NoSQL.

MODULE II RELATIONAL DATABASE DESIGN AND STORAGE STRUCTURE **15 Hours**

Relational Database Design – Principles of a good schema design-functional dependencies - Armstrong's axioms for FD's - definitions of 1NF - 2NF - 3NF- BCNF- 4NF - Data Storage and Indexes - file organizations - primary and secondary index structures - B+ trees index structures - Static and dynamic hashing Techniques.

MODULE III TRANSACTION PROCESSING AND SECURITY **15 Hours**

Transaction Processing - ACID property - Serializability of scheduling - Concurrency control : Lock based concurrency control – Timestamp Based Database recovery. Database Security: Authentication - Authorization and access control - **Case Study :** Web databases, Distributed databases – MongoDB

Total Hours: 45

Text Books:

1	Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, 7thEdition, Tata McGraw Hill, March 2019.
2	Gupta G K, “Database Management Systems”, Tata McGraw Hill Education Private Limited,New Delhi, 2012.

Reference Books:

1	RamezElmasri, ShamkatB.Mavathe, ”Database Systems”, 6th Edition, Pearson Education,2013.

2	Michael McLaughlin, “Oracle Database 12c PL/SQL Programming”, Tata McGraw Hill Education Private Limited, New Delhi, 2014.
3	Gaurav Vaish, “Getting Started with NoSQL”, Packt Publishing, March 2013.
Web References:	
1	http://www.nptel.ac.in
2	http://www.sqlcourse.com
3	http://www.edureka.co/mongodb
4	https://alison.com/courses/IT-Management-Software-and-Databases
Online Sources:	
1	https://www.coursera.org/learn/database-management
2	https://www.udemy.com/database-management-system/
3	http://www.nptelvideos.in/2012/11/database-management-system.html

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C001.1	Understand	Quiz	20
C001.2	Apply	Tutorial	20
C001.3	Apply	Group Assignment	20
C001.4	Analyze		
C001.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30

Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C001.1	2	2	2								2	2	2		2
C001.2	2	2	2								2	2	2		2
C001.3	2	2	2								2	2	2		2
C001.4	3	3	3								2	2	2		2
C001.5	3	3	3								2	3	3		2

21AD002	INFORMATION RETRIEVAL TECHNIQUES	2/0/2/3

Nature of Course	F (Theory Programming)
Prerequisites	Nil

Course Objectives:

1	To understand the basics of Information Retrieval.
2	To understand data modeling and Retrieval Evaluation.
3	To develop the fundamental understanding of Classification and Clustering in Information Retrieval.
4	To apply the concepts of web retrieval and crawling for a search engine.
5	To learn different techniques of the recommender system.

Course Outcomes: Upon completion of the course, students shall have ability to:

C002.1	Use an open source search engine framework and explore its capabilities.	[U]
C002.2	Explain the foundations of information retrieval, design, analysis and implementation of IR systems.	[U]
C002.3	Apply appropriate methods of classification or clustering.	[AP]
C002.4	Explore the methods and techniques to classify text documents.	[A]
C002.5	Design and implement innovative features in a search engine.	[AP]
C002.6	Design and implement a recommender system.	[AP]

Course Contents:

MODULE I Introduction - IR, Modelling and Retrieval Evaluation **15 Hours**

Motivation - IR System Architecture - Retrieval Process - Web: Introduction and Characteristics - The Impact of The Web on IR - IR Versus Web Search -Challenges - Search Engines. Basic IR Models - Boolean Model - Vector Model - Probabilistic Model - Set Theoretic Models - Algebraic Models - Structured Text Retrieval Models - Models for Browsing - Retrieval Evaluation and Metrics - Precision and Recall - Reference Collection - User -based Evaluation - Relevance Feedback and Query Expansion - Explicit Relevance Feedback.

MODULE II Classification and Clustering **15 Hours**

A Characterization of Text Classification - Unsupervised Algorithms: Clustering - Naive Text Classification - Supervised Algorithms - Decision Tree - K-NN Classifier - SVM Classifier - Feature Selection or Dimensionality Reduction - Evaluation metrics - Accuracy and Error - Organizing the classes - Indexing and Searching - Inverted Indexes - Sequential Searching - Multidimensional Indexing.

MODULE III Web Retrieval, Web Crawling and Recommender Systems **15 Hours**

The Web - Search Engine Architectures - Cluster based Architecture - Distributed Architectures - Search Engine Ranking - Link based Ranking - Evaluations - Search Engine User Interaction - Browsing - Applications of a Web Crawler - Taxonomy - Architecture and Implementation - Scheduling Algorithms - Evaluation. Recommender Systems Functions - Data and Knowledge Sources -Recommendation Techniques - Content based Recommender Systems - Collaborative Filtering - Matrix factorization models - Neighborhood models. Case Study: IR using Python - PyTerrier.

Total Hours:	**45**

Text Books:

1	Ricardo Baeza -Yates and Berthier Ribeiro-Neto, - Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2.	Stefan Büttcher, Charles L. A. Clarke, Gordon V. Cormack “Information Retrieval Techniques”, 2016.
3.	Ricci, F, Rokach, L. Shapira, B.Kantor, - Recommender Systems Handbookll, First Edition, 2011.

Reference Books:	
1	Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to information Retrieval”, Cambridge university press, first south asian edition 2012.
2	Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, - Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.
3	G. Salton and M. J. McGill, Introduction to Modern Information Retrieval, McGraw-Hill, 1983.
Web References:	
1	https://www.lisbdnetwork.com/online-information-retrieval-syste/
2	https://www.youtube.com/watch?v=McVpRWiAP2I&list=PLMyP8LIIL3ht_WV4EXjN-uD3EPEK3hIyu
3	https://www.youtube.com/watch?v=h9gpufJFF-0

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom’s Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C002.1	Understand	Quiz	20
C002.2	Apply	Tutorial	20
C002.3	Apply	Group Assignment	20
C002.4	Understand		
C002.5 & C002.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom’s Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

* SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
* FA1 & FA 2 are internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
* ES exams conducted and evaluated for 100 marks.

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C002.1	3	3	3	2	2							2	3	3	2
C002.2	3	3	2	2	2							2	2	2	2
C002.3	3	3	3	3	2							2	2	2	3
C002.4	3	3	3	2	3							2	2	2	3
C002.5	3	3	3	3	2							2	2	2	2
C002.6	3	3	3	3	3							2	2	2	2

21AD004	DATA VISUALIZATION USING R	2/0/2/3

Nature of Course	F (Theory Programming)
Prerequisite	Nil

Course Objectives:

1	Understand the principles of data and graphic design.
2	Evaluate the credibility, ethics, and aesthetics of data visualizations.
3	Know how to evaluate and criticize data visualizations based on principles of analytic design.
4	Be in the position to explore and present their data with visual methods.
5	Importance of analytics and visualization in the era of data abundance.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C004.1	Use RStudio to develop, test, and execute R scripts.	[AP]
C004.2	Use RStudio to perform basic data analysis functions including Input/Output, basic Exploratory Data Analysis (EDA), and graphical output.	[AP]
C004.3	Understand which graphical formats are useful for which types of data and questions	[AP]
C004.4	Share data and graphics in open forums.	[AP]
C004.5	Create well-designed data visualizations with appropriate tools.	[AP]
C004.6	Know how to construct compelling visualizations using the free statistics software R	[AP]

Course Contents:

MODULE I INTRODUCTION TO R **15 Hours**

Introduction to R and R studio- Data Inputting in R- Functions and Programming in R – Data Manipulation in R - Statistical Modelling in R- Advanced Data handling - Combined and restructuring data frames.

MODULE II INTRODUCTION TO DATA VISUALIZATION **15 Hours**

Introduction to Data Visualization –principles of analytic design plotting techniques- gg plot- Bar charts- Histograms- pie chart – Multidimensional data- visualization relations between variables.

MODULE III BASIC PLOTS, MAPS, AND CUSTOMIZATION **15 Hours**

Scatter plot- Line plot- Box plots- Customize plots- Scatter plot matrices -Conditioning plots -Lattice graphs - Interaction plots - Themes and faceting- v2.2.3 - Maps with Leaflet. **Case study:** Data Visualization for covid-19 dataset.

Total Hours:	**45**

Text Books:

1	Hadley Wickham, Garrett Grolemund , “R for data science : Import, Tidy, Transform, Visualize, And Model Data”, O;reilly 2017.
2	Rajesh K Maurya , Swati R Maurya, “R Programming for Data Analytics & Visualization”, SYBGEN learning, 2021.

Reference Books:

1	Tony Fischetti, Brett Lantz, “R: Data Analysis and Visualization”, Packt Publishing, 2016.
2	Thomas Rahlf, “Data Visualisation with R”, Springer, 2019.
3	Claus O. Wilke, “Fundamentals of Data Visualization”, O’Reilly, 2019.

Web References:

1	https://www.coursera.org/learn/data-visualization-r
2	https://slcladal.github.io/dviz.html

Continuous Assessment	End	Total

Formative Assessment	Summative Assessment	Total	Total Continuous Assessment	Semester Examination	
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C004.1	Apply	Quiz	20
C004.2	Apply	Tutorial	20
C004.3	Apply	Group Assignment	20
C004.4	Apply		
C004.5	Apply	Presentation	20
C004.6			

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

ourse Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C004.1	3	3	3	2	3	2						2	2	2	2
C004.2	3	3	3	2	3	2						2	2	2	2
C004.3	3	3	3	3	3	2						2	2	2	2
C004.4	3	3	3	2	3	2						2	2	3	3
C004.5	3	3	3	3	3	3						3	3	2	2
C004.6	3	3	3	3	3	3						3	3	2	2

21AD005	INTRODUCTION TO DATA ANALYTICS	2/0/2/3

Nature of Course	F (Theory Programming)
Prerequisite	Nil

Course Objectives:

1	Understand the Big Data Platform and its Use cases
2	Learn to build and maintain reliable, scalable, distributed systems with Apache Hadoop
3	Provide an overview of Apache Hadoop
4	To able to apply Hadoop ecosystem components
5	Develop a big data solution using Hive.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C005.1	Understand Big Data and its analytics in the real world	[U]
C005.2	Recognize the analytics tool.	[U]
C005.3	Analyze the Big Data framework like Hadoop to efficiently store and process Big Data to generate analytics	[A]
C005.4	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm	[AP]
C005.5	Implement Big Data Activities using Hive ,Hiveql and Hbase.	[AP]
C005.6	Design applications with Zookeeper	[AP]

Course Contents:

INTRODUCTION TO BIG DATA **15 Hours**

Evolution of Big data — Best Practices for Big data Analytics — Big data characteristics-Four Vs, Drivers for Big data, Big data analytics, Big data applications-.Classification of Analytics – Top Analytics Tools.

HADOOP AND MAP REDUCE PROGRAMMING MODEL **15 Hours**

Apache Hadoop & Hadoop EcoSystem – Moving Data in and out of Hadoop -Hadoop Architecture, Hadoop Storage: HDFS Understanding inputs and outputs of MapReduce-MapReduce: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

HIVE AND HIVEQL, HBASE **15 Hours**

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Total Hours:	**45**

Text Books:

1	Seema Acharya, SubhashiniChellappan, “Big Data and Analytics”, Wiley Publications, First Edition,2015
2	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007. 2. Tom White “ Hadoop: The Definitive Guide” Third Edition, O"reilly Media, 2011

Reference Books:

1	Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013)
2	Tom White, “Hadoop The Definitive Guide”, O’Reilly Publications, Fourth Edition, 2015

Web References:

1	https://nptel.ac.in/courses/106104189

2	https://www.coursera.org/learn/google-data-analytics-capstone

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C005.1 C005.2	Understand	Quiz	20
C005.3	Analyze	Tutorial	20
C005.4	Apply	Group Assignment	20
C005.5	Apply		
C005.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C005.1	3	3	3	2	3	2						2	2	2	2
C005.2	3	3	3	2	3	2						2	2	2	2
C005.3	3	3	3	3	3	2						2	2	2	2
C005.4	3	3	3	2	3	2						2	2	3	3
C005.5	3	3	3	3	3	3						3	3	2	2
C005.6	2	2	2									2	2	2	2

20AD006	INTRODUCTION TO DEEP LEARNING	2/0/2/3

Nature of Course	H (Theory Technology)
Prerequisite	Nil

Course Objectives:

1	To explain the basic concepts of neural networks.
2	To discuss the fundamentals of deep networks.
3	To examine the major architectures in deep networks.
4	To demonstrate the applications of deep learning.
5	To Analyze, critique, and revise data visualizations

Course Outcomes:

Upon completion of the course, students shall have ability to:

C006.1	Describe the fundamentals of Neural networks.	[U]
C006.2	Distinguish neural and deep networks.	[U]
C006.3	Build Deep Learning models with Keras in TensorFlow.	[AP]
C006.4	Identify the appropriate deep network architecture for an application.	[AP]
C006.5	Apply various deep learning techniques to design efficient algorithms for real-world applications.	[AP]
C006.6	Analyze the performance of a deep learning network.	[A]

Course Contents:

Module I: Foundations of Neural Networks **15 Hours**

Neural Networks – Training Neural Networks – Activation Functions - Loss Functions – Hyper parameters. Supervised Learning and Unsupervised Learning. **F**undamentals of Deep Networks – Introduction to Deep Learning – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks.

Module II: Major Architectures of Deep Networks **15 Hours**

Unsupervised Pre-Trained Networks – Convolution Neural Networks - Transfer learning Techniques - Recurrent Neural Networks - Stochastic Gradient Descent – Recursive Neural Networks, Long Short-Term Memory (LSTM) Networks - Introduction to Deep Learning Tools: Tensor Flow, Keras.

Module III: Applications **15 Hours**

Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision – **Case Study:** Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

Total Hours: 45

Text Books:

1	Adam Gibson, Josh Patterson, “Deep Learning, A Practitioner’s Approach”, O'Reilly Media, 2017.
2	Ian Good fellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 2017.
3	Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4	Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks” Apress, 2018.

Reference Books:

1	Daniel Graupe, “Deep Learning Neural Networks: Design and Case Studies”, World Scientific Publishing ,2016.
2	Yu and Li Deng, “Deep Learning: Methods and Applications”, Now Publishers Inc,2014.
3	Zurada,J.M. “Introduction to Artificial Neural Systems”, Jaico Publishing House,2012.

4	Giancarlo Zaccone , Md. RezaulKarim , Ahmed Menshawy, ”Deep Learning with tensorflow : Explore neural networks and build intelligent systems with Python", Packt Publisher, 2020.
5	Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.
Web References:	
1	http://deeplearning.cs.cmu.edu/
2	http://deeplearning.net/
Online Resources:	
1	http://nptel.ac.in/courses/
2	https://www.udacity.com/course/deep-learning--ud730
3	https://bigdatauniversity.com/courses/introduction-deep-learning/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)

Formative Assessment based on Capstone Model

Course Outcome	Bloom's Level	Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)	FA (16%) [80 Marks]
C006.1	Understand	Quiz	20
C006.2	Apply	Tutorial	20
C006.3	Apply	Group Assignment	20
C006.4	Understand		
C006.5 & C006.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination

Bloom's Level	Summative Assessment (24%) [120 Marks]		End Semester Examination (60%) [100 Marks]
	CIA1 : [60 Marks]	CIA2 : [60 Marks]	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

* SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
* FA1 & FA 2 are internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
* ES exams conducted and evaluated for 100 marks.

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C006.1	3	3	3	2	3	2	2		2			2	2	2	2
C006.2	3	3	3	3	3	2	2		2			2	3	3	2
C006.3	3	3	3	3	3	3	3		3			3	3	3	3
C006.4	3	3	3	3	3	3	3		3	2		3	3	3	3
C006.5	3	3	3	3	3	3	3	2	3	2	2	3	3	3	3
C006.6	3	3	3	3	3	3	3	2	3	2	2	3	3	3	3

21AD007	AUTONOMOUS SYSTEMS AND DRONES	3/0/0/3
Nature of Course	D (Theory Applications)	
Prerequisite	UAV Technology and Remote Sensing	

Course Objectives:

1	To gain insight into the basic elements of drone systems used in civilian missions.
2	To introduce SLAM (Simultaneous Localization And Mapping) including drones and autonomous SLAM with sensors.
3	To Understand the regulatory procedures of drones, pilot certification and licensing and basic safety measures required of UAS / UAV.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C007.1	Understand the evolution and classification of Drones / SLAM (Simultaneous Localization And Mapping)	[U]
C007.2	Illustrate the commercial applications used by various types of drones	[A]
C007.3	Apply their knowledge in different types of flight controllers	[AP]
C007.4	Gain knowledge on UAVs technology side of things (sensors, platforms, navigation, power source, communication, range, altitude and speed).	[AP]
C007.5	Learn the essential components and platforms for Drones	[U]
C007.6	Develop the ability to build commercial drones using drone kits.	[AP]

Course Contents:

MODULE I INTRODUCTION AND FUNCTIONAL ARCHITECTURE 15 Hours

Basic Concept- autonomous systems- AI in autonomous systems,-Autonomous systems vs robots-Major functions in an autonomous vehicle system-Motion Modelling - Coordinate frames and transforms-Point mass model.

MODULE II SLAM 15 Hours

Modeling in autonomous systems Vehicle modeling (kinematic and dynamic bicycle model - two-track models),-Sensor Modelling – encoders- inertial sensors- GPS- Localization and mapping fundamentals-LIDAR and visual SLAM, Navigation - Global path planning- Local path planning- Vehicle control - Control structures,-PID control, Linear quadratic regulator,-Sample controllers.

MODULE III DRONES 15 Hours

Overview-Definition,-applications,-components platforms- propulsion,-on-board flight control,-payloads- communications,-concepts of flight-regulatory norms and regulations,-Machine learning and deep learning for autonomous driving,-Case study(Commercial Drones and Kits.

Total Hours: 45

Text Books:

1	Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot,"Creating Autonomous Vehicle Systems" Morgan & Claypool Publishers, 2018
2	John Baichtal "Building your own Drones A beginners Guide to Drones, UAVs and ROVs", Que Publishing 2016.

Reference Books:

1	Mohammad H. Sadraey "Design of Unmanned Aerial Systems" First Edition, John Wiley & Sons, Inc., USA 2020.
2	Terry Kilby and Belinda Kilby Make "Getting Started with Drones" First Edition, Maker Media Inc,San Francisco CA, 2016

Web References:

1	https://www.coursera.org/learn/Drones

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C007.1,C007.5	Understand	Quiz	20
C007.2	Analyze	Tutorial	20
C007.3,4	Apply	Group Assignment, Presentation	40
C007.6	Apply		

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks			
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)		
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)	

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C007.1	3	3	3	3	2								2	2	2
C007.2	3	2	3	3	2								2	3	2
C007.3	3	2	3	3	2										
C007.4	3	3	3	3	2										
C007.5	3	3	3	3	2									2	
C007.6	3	3	3	3	2	2	2	2	2		2		3	3	3

21AD008	CRYPTO CURRENCIES	3/0/0/3

Nature of Course C (Theory Concept)

Prerequisites: Cryptography and Network Security

Course Objectives:

1	To explain the fundamental ideas of crypto currencies.
2	To explore the Block chain concept and mining.
3	To examine the concept of distributed ledger and Bitcoin.
4	To discuss various aspects of Ethereum.
5	To understand legal issues of crypto currencies and associated security challenges.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C008.1	Discuss the fundamentals of cryptographic systems.	[U]
C008.2	Interpret the structure and implementation of the Blockchain.	[U]
C008.3	Describe the operation of Bitcoin.	[U]
C008.4	Apply mining strategies for implementation of crypto currencies.	[AP]
C008.5	Illustrate the legal issues of crypto currencies.	[AP]
C008.6	Articulate the security issues and challenges of crypto currencies.	[AP]

Course Contents:

Fundamentals of Cryptography and Blockchain **15 Hours**

Introduction to Cryptography & Crypto currencies: Cryptographic Hash Functions - Hash Pointers and Data Structures - Digital Signatures – Secret Key Encryption - Public-key encryption - Public Keys as Identities - A Simple Crypto currency. **The Blockchain:** Introduction -Advantage over conventional distributed database - Blockchain Network- Mining Mechanism - Distributed Consensus Structure of a Block – Block Header – Block identifiers – The Genesis Block – Linking Blocks – Merkle Trees – Simplified Payment Verification.

Crypto currencies **15 Hours**

History - Distributed Ledger - Nakamoto consensus - Proof of Work- Proof of Stake - Proof of Burn – Introduction to Bitcoin - Transactions, Blocks, Mining, and the Blockchain - Bitcoin Transactions - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin, Altcoins.

Real world Applications and Challenges **15 Hours**

Legal aspects of virtual currency - Stockholders, Roots of Bitcoin, Legal Aspects - Cryptocurrency Exchange, Black Market and Global Economy - post-quantum cryptography - Segregated witness benefits – Mimblewimble - Bitcoin as a Platform – Append only log – Smart property – Security Principles – User Security best practices. **Case Study:** pycoin.

Total Hours: 45

Text Books:

1	Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction by Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press; 2nd Ed.2019.
2	Mastering Bitcoin: Unlocking Digital Cryptocurrencies by Andreas M. Antonopoulos, 2nd Edition, O'Reilly Publishers, 2010.
3	Bitcoin, Blockchain, and Crypto Assets: A Comprehensive Introduction by Fabian Schär and Aleksander Berentsen, MIT Press, 2020.

Reference Books:

1	An Introduction to Cryptocurrencies - The Crypto Market Ecosystem by Nikos Daskalakis, Panagiotis Georgitseas, Routledge, 2020.

2	Fundamentals of Blockchain by Ravindhar Vadapalli, Blockchainprep, 2020.
3	Cryptography and Network Security: Principles and Practice by William Stallings, 7th Edition, Pearson education, 2017.
Web References:	
1	https://www.coursera.org/learn/crypto-finance
2	https://www.udemy.com/course/complete-course-on-blockchain-and-crypto-currency/
3	https://courses.dcxlearn.com/p/blockchain-and-cryptocurrency-the-basics
Online Resources:	
1	https://media2.mofo.com/documents/170900-understanding-blockchain-cryptocurrencies.pdf
2	https://scet.berkeley.edu/wp-content/uploads/BlockchainPaper.pdf
3	https://bitcoin.org/bitcoin.pdf

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C008.1 & C008.2	Understand	Quiz	20
C008.3	Apply	Tutorial	20
C008.4	Apply	Group Assignment	20
C008.5	Understand		
C008.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					End Semester Examination (60%) [100 Marks]
CA 1 : 100 Marks			CA 2 : 100 Marks		
SA 1 (60 Marks)	FA 1 (40 Marks)		SA 2 (60 Marks)	FA 2 (40 Marks)	
	Component - I (20 Marks)	Component - II (20 Marks)		Component - I (20 Marks)	Component - II (20 Marks)

* SA 1 & SA 2 are continuous internal examination conducted each for 100 marks
* FA1 & FA 2 is internal components conducted as per syllabus requirements. Each Component evaluated for 10 marks each.
* ES exams conducted and evaluated for 100 marks.

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C008.1	3	3	3	2	2								3		2
C008.2	3	3	3	2	2								3		2
C008.3	3	3	3	3	2								2		2
C008.4	3	3	3	2	2	2	2	2	2	2		2	2		2
C008.5	3	3	3	3	2	2	2	2	2	2		2	2	2	2
C008.6	3	3	3	3	2	2	2	2	2	2		2	2	2	2

21AD009	AI IN HEALTH CARE APPLICATIONS	3/0/0/3

Nature of Course	F (Theory Programming)
Prerequisite	Artificial Intelligence

Course Objectives:

1	To Identify healthcare myths and digital transformation.
2	To gain knowledge in Precision Medicine and Intelligent Personal Health records.
3	To Understand AI Healthcare operations and Innovation.
4	To familiar with AIOps Strategy.
5	To analyze the future healthcare technologies.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C009.1	Understand about Health care myths and Digital Transformation.	[U]
C009.2	Recognize Health Records analytics.	[U]
C009.3	Identify the various healthcare operations.	[A]
C009.4	Develop an understanding in security services.	[A]
C009.5	Learn about telemedicine and their innovation.	[U]
C009.6	Apply principles and algorithms to evaluate a model.	[AP]

Course Contents:

MODULE I: INTRODUCTION **15 Hours**

AI health care myths - Human centered AI - Prescription for Personal Health - Ambient Computing Healthcare - Continuous monitoring using AI-Precision medicine -Intelligent Personal Health records - Digital Transformation.

MODULE II: AI HEALTHCARE OPERATIONS **15 Hours**

AIops strategy- Clinical Impact of AIops - Data Analytics and AI-Design and Innovation - AIops for Healthcare Delivery-AIOps for service performance - HIPAA, PH1, PII Protection - AIOps Usecase.

MODULE III: FUTURE OF HEALTHCARE **15 Hours**

Role of Medical Imaging Computing - AI in Radiology and Practical Use cases - Chronic Disease Management-AI Telemedicine - Telehealth Innovation-Digital Medication -Case Study: Cancer diagnostics and treatment decisions.

Total Hours:	**45**

Text Books:

1	Kerrie L. Holley, Siupo Becker, “AI -First Healthcare”, O'Reilly Media, Inc., 2018.
2	Adam Bohr, Kaveh Memarzadeh, “Artificial Intelligence in Healthcare”, Elsevier Science, 2020.

Reference Books:

1	Robert Shimonski, Robert Shimonski”, “How Artificial Intelligence Is Changing IT Operations and Infrastructure Services” , wiley, 2020.

Web References:

1	https://www.coursera.org/specializations/ai-healthcare
2	https://www.udemy.com/course/the-complete-healthcare-artificial-intelligence-course-2021

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C009.1	Understand	Quiz	20
C009.2	Apply	Tutorial	20
C009.3	Apply	Group Assignment	20
C009.4	Understand		
C009.5 & C009.6	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination					
Continuous Assessment (40%) [200 Marks]					**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**		
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**	
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C009.1		1	3	3	3							1	3	3	3
C009.2	1	2	3	3	3	1						1	3	3	3
C009.3	2	2	3	3	2							1	3	3	3
C009.4	2	1	3	3	3							1	3	3	3
C009.5	2	1	2	3	2	1						1	3	3	3
C009.6	3	3	3	3	2				2	2		1	3	3	3

21AD010	SCALABLE SYSTEM FOR DATA SCIENCE	3/0/0/3

Nature of Course	C (Theory Concept)
Prerequisite	Nil

Course Objectives:

1	To study the fundamental Systems aspects of designing and using Big Data platforms.
2	To study the approaches and design patterns to translate existing data-intensive algorithms and analytics into these distributed programming abstractions.
3	To get exposure to scalable systems for data science applications.
4	To study the types of Big Data, Design goals of Big Data platforms.
5	To design and create small real time applications.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C010.1	Understand the basics of scalable systems.	[U]
C010.2	Understand the concepts of processing large volumes of big data.	[U]
C010.3	Describe the attributes of big data storage systems.	[A]
C010.4	Create the understanding of machine learning over big data.	[AP]
C010.5	Apply their knowledge to design solutions to different problems.	[AP]
C010.6	Analyze various application related to machine learning	[AP]

Course Contents:

MODULE I BIG DATA & DISTRIBUTED SYSTEMS **15 Hours**

Introduction to Big Data - Storage, compute, visualization, Files vs. Overview of Relational Databases vs. NoSQL Databases - Big Data systems: HBase/Big Table, Cassandra/Key-Value Store, Graph DB overview - Clusters, Cloud computing, Edge computing - Cloud storage.

MODULE II PROCESSING LARGE VOLUMES OF BIG DATA **15 Hours**

Big Data Processing with MapReduce and Spark - Spark Basics – RDD – transformations – action -Shuffle - Spark internals - Spark tuning – Google File System – Hadoop File System.

MODULE III MACHINE LEARNING AT SCALE **15 Hours**

ML over Big Data –TensorFlow - Parameter server and Federated learning - Spark ML for ML pipelines - **Case Study:** Scalable training and inferencing over graph neural networks, Scalable pattern mining and analysis over Twitter streams, Distributed video analytics over drone (Tello) video feeds.

Total Hours:	**45**

Text Books:

1	J. Leskovec, A. Rajaraman and JD Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2nd Edition, 2020.
2	Mahoney, Michael W. "Randomized algorithms for matrices and data - Foundations and Trends in Machine Learning”, 3rd Edition, 2011.

Reference Books:

1	Woodruff, David P, "Sketching as a tool for numerical linear algebra”, Foundations and Trends in Theoretical Computer Science, 2014.
2	Cathy O’Neil and Rachel Schutt, "Doing Data Science: Straight Talk from the Frontline", O’ Reilly, 2020.

Web References:

1	https://cds.iisc.ac.in/courses/ds256/
2	https://cds.iisc.ac.in/wp-content/uploads/DS256.2017.L1.Introduction.pdf

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C010.1	Understand	Quiz	20
C010.2	Understand	Tutorial	20
C010.3	Analyze	Group Assignment	20
C010.4	Apply		
C010.5	Apply	Presentation	20
C010.6			

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C010.1	3	3	3	2	3	2						2	2	2	2
C010.2	3	3	3	2	3	2						2	2	2	2
C010.3	3	3	3	3	3	2						2	2	2	2
C010.4	3	3	3	2	3	2						2	2	3	3
C010.5	3	3	3	3	3	3						3	3	2	2
C010.6	3	3	3	3	3	3						3	3	2	2

21AD011	COMPUTER VISION	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Machine Learning	

Course Objectives:

1.	To provide a glimpse of what computer vision is about and its applications.
2.	To give an understanding of image processing for computer vision.
3.	To develop an appreciation for various issues in the design of computer vision and object recognition systems
4.	To focus on early processing of images and the determination of structure: edges, lines, shapes.
5.	To provide the student with programming experience from implementing computer vision and object recognition applications.

Course Outcomes

Upon completion of the course, students shall have ability to

C011.1	Understand major concepts and techniques in computer vision and image processing.	[U]
C011.2	Analyze and design a range of algorithms for image processing.	[A]
C011.3	Choose different feature extraction techniques for image analysis and recognition	[AP]
C011.4	Identify the different causes for image degradation and overview of image restoration techniques.	[AP]
C011.5	Examine and develop practical and innovative image processing and computer vision applications or systems.	[A]
C011.6	Relate and identify solutions to problems in computer vision.	[U]

Course Contents:

INTRODUCTION AND IMAGE FORMATION: **15 Hours**

Computer vision Introduction, Computer Vision vs Image Processing Image Formation – Geometric primitives and transformations, 2D transformations,3D transformations, 3D rotations, 3D to 2D projections, Lens Distortion - Photometric image formation- Lightning, Reflectance and Shading, Optics The digital camera – Sampling and Aliasing, Color, Compression. **Case Study:** Open CV

IMAGE PROCESSING AND RECOGNITION: **15 Hours**

Point Operators – Transformations – Orthogonal, Euclidean, Affine and Projective, Linear Filtering, Non linear Filtering, Bilateral Filtering Fourier Transforms,2D Fourier Transforms, Applications – Sharpening, blur and Noise Removal, Image Enhancement Restoration, Histogram Processing. Recognition – Instance Recognition, Image Classification, Object Detection, Face Detection, Pedestrian Detection, General Object Detection, Semantic Segmentation- Medical Image Segmentation, Intelligent Photo Editing.

FEATURE DETECTION AND MATCHING AND 3D MOTION **15 Hours**

Points and Patches, Edges and Contours, Contour Tracking , lines and Vanishing Points.3D Vision and methods, Projection schemes, shape from shading, photometric stereo, shape from texture, shape from focus, active range finding, surface representations, point based representations, volumetric based representations, 3D object Detection.3D reconstruction,3D Scanning, Introduction to Motion, Triangulation, bundle adjustment, translational alignment, Parametric Motion, Spline based Motion , Optical Flow, layered motion. Case Study : Digital Heritage, 3D Model Capture.

	Total Hours	**45**
Text Books:		
1.	Richard Szeliski, "Computer Vision: Algorithms and Applications", The University Washington, 2nd Edition, Springer, 2022.	
2.	D.L Baggio, “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2017.	
3.	E.R Davies,” Computer and Machine Vision”, Fourth Edition, Academic Press, 2012.	
Reference Books:		
1.	Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O’Reilly Media, 2012.	
2.	Simon J.D Prince, “Computer Vision: Models, Learning and Inference”, Cambridge University Press, 2012.	
Web References:		
1.	https://pyimagesearch.com/	
2.	https://omscs.gatech.edu/cs-6476-computer-vision-course-videos	

3.	http://www.cse.iitm.ac.in/~vplab/computer_vision.html
Online Resources:	
1.	https://www.coursera.org/learn/computer-vision-basics
2.	https://onlinecourses.nptel.ac.in/noc20_cs88/preview
3.	https://cloudxlab.com/course/99/computer-vision

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C011.1, C011.6	Understand	Quiz	20
C011.2	Analyze	Tutorial	20
C011.3	Apply	Group Assignment	20
C011.4	Analyze		
C011.5	Apply	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30

Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1 : 100 Marks			**CA 2 : 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C011.1	3	3	2									2	2		2
C011.2	2	2	3									2			2
C011.3	2	3	2									2			2
C011.4	2	3	3									3			2
C011.5	3	2	3									3			3
C011.6	3	2	2									3	2	2	3

21AD012	DATA ENGINEERING ON GOOGLE CLOUD PLATFORM	3/0/0/3

Nature of Course	F (Theory Programming)
Pre-Requisite	NIL

Prerequisites: Big Data and Machine Learning

Course Objectives:

1	To discuss the essence of front-end development skills.
2	To impart the knowledge of React components used in Big DataS development platforms.
3	Ability to understand and use Setup Cloud MySql
4	To deploy and test the React App used in Big Query.
5	To learn the Pipeline concepts using IOT

Course Outcomes:

Upon completion of the course, students shall have ability to:

C012.1	Identify the basic concepts and design issues of operating systems.	[R]
C012.2	Understand the principles of process and threads	[U]
C012.3	Illustrate the approaches in scheduling and Bigquery to apply in real world problems.	[AP]
C012.4	Apply concepts of Visualizing Data including Google Cloud Platform to the issues that occur in Real time applications	[AP]
C012.5	Identify issues related to Legal Compliance, Data Analytics,Data Warehouse	[AP]
C012.6	Examine common Google Cloud Platform, Availability and Scalability.	[A]

Course Contents:

MODULE I FUNDAMENTALS OF DATA ENGINEERING AND BATCH PROCESSING 15 Hours

Introduction-Data life Cycle- Roles of Data Engineer-Data Warehouse-BigData On GCP-GCP Components-Google Cloud Platform-Data Warehouse in BigQuery- Data Ingestion into Bigquery/GCS using Sqoop on Dataproc-Setup Cloud MySql Instance & Database.Orchestration for Batch Processing.

MODULE II GOOGLE CLOUD STORAGE AND BIG QUERY 15 Hours

Introduction-BigQuery Console- Pyspark on Dataproc-Automate Jobs using Apache Airflow-Google Workflow. -Sqoop Basic-Data orchestration Job Automation using Google Workflow-Data Lake-Dataproc-Replications-Designing pipeline- Bigquery as the DWH-Spark Dstreams API and Spark-Process Time Streaming .Data warehouse Component.

MODULE III ML ON GOOGLE CLOUD PLATFORM 15 Hours

Basic Concepts-Visualizing Data-Data Driven Decision with Data Studio-BI Engine Works-MLops Landscape in GCP-GCP in AutoML-AI Pipeline-IAM –End to End Data Solutions-CI/CD and Components-IOT Sensor Data Energy Consumption- Managed Cluster-Data Staging-Data Residency Requirements-ACID-Dataprep-LegalCompliance(HIPAA,COPPA,FedRamp,GDPR)-Casestudy-Operationalizing Scalable Data Analytics System on GCP.

Total Hours:	**45**

Text Books:

1	Adi Wijaya, “Data Engineering with Google Cloud Platform” A practical guide to operationalizing scalable data analytics systems on GCP, -Import, January 2021.

Reference Books:

1	Manoj Kukreja, Danil Zburivsky, “Data Engineering with Apache Spark” Delta Lake, and Lakehouse,Packt Publishing,2021.
2	Rudy Lai, Bartłomiej Potaczek,”Hands-On Big Data Analytics with PySpark” ,Packt Publishing, 2019.

Web References:	
1	https://www.data-engineering-with-google-cloud-platform/

Continuous Assessment				End Semester Examination	Total
Formative Assessment	Summative Assessment	Total	Total Continuous Assessment		
80	120	200	40	60	100

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C012.1	Remember	Quiz	20
C012.2	Understand	Tutorial	20
C012.3	Apply	Group Assignment	20
C012.4&C012.5	Apply		
C012.6	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1 : [60 Marks]	**CIA2 : [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyze	30	30	30
Evaluate	-	-	-
Create	-	-	-

<table>
<tr><th colspan="6">Assessment based on Continuous and End Semester Examination</th></tr>
<tr><th colspan="5">Continuous Assessment (40%)
[200 Marks]</th><th rowspan="3">End Semester Examination (60%)
[100 Marks]</th></tr>
<tr><th colspan="3">CA 1 : 100 Marks</th><th colspan="2">CA 2 : 100 Marks</th></tr>
<tr><th rowspan="2">SA 1
(60 Marks)</th><th colspan="2">FA 1 (40 Marks)</th><th rowspan="2">SA 2
(60 Marks)</th><th colspan="2">FA 2 (40 Marks)</th></tr>
<tr><th>Component - I
(20 Marks)</th><th>Component - II
(20 Marks)</th><th>Component - I
(20 Marks)</th><th>Component - II
(20 Marks)</th></tr>
</table>

Course Outcomes (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C012.1	2	2	2		2									2	
C012.2	2	3	2		2									2	
C012.3	2	2	2		2									2	
C012.4	2	3	2		3	2							3	2	3
C012.5	2	2	2		2	3								2	
C012.6	2	2	2		2								2	2	2

21AD013	PREDICTIVE ANALYTICS	3/0/0/3
Nature of Course	C (Theory Concept)	
Pre requisites	Machine Learning Techniques and Database Management Systems	

Course Objectives:

1.	To Develop skills to process and analyze complex data sets
2.	To learn, how to develop models to predict categorical and continuous outcomes, using techniques such as decision trees, logistic regression, random forest.
3.	To understand the different types of Data visualization, Distributions and summary statistics.
4.	To know the use of the binary classifier and numeric predictor nodes to automate model selection.
5.	To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

Course Outcomes

Upon completion of the course, students shall have ability to

C013.1	Illustrate the process to successfully design, build, evaluate and implement predictive models for a various business application.	[U]
C013.2	Select appropriate predictive modeling approaches to identify cases to progress with.	[R]
C013.3	Identify the real-world business problems and model with analytical solutions.	[AP]
C013.4	Apply predictive modeling approaches and evaluate the performance.	[AP]
C013.5	Convert any real-world decision-making problem to hypothesis and apply suitable statistical testing.	[A]

Course Contents:

PREDICTION AND CLASSIFICATION METHODS: 15 Hours

Explanatory vs Predictive Modeling – Multiple Linear Regression, Classification Tress, Avoiding Overfitting - Regression Trees, Improving Prediction: Random Forests and Boosted Trees, Logistic Regression, Discriminant Analysis.

MEDIA ANALYTICS: 15 Hours

Social Network Analytics - Directed vs. Undirected Networks - Visualizing and Analyzing Networks - Social Data Metrics and Taxonomy - Using Network Metrics in Prediction and Classification – Text Mining - Bag-of-Words vs. Meaning Extraction at Document Level – **Case Study:** Catalog Cross-Selling - Predicting Bankruptcy**.**

PERFORMANCE EVALUATION: 15 Hours

Evaluating Predictive Performance - Judging Classifier Performance - Judging Ranking Performance - Oversampling: Oversampling the Training Set, Evaluating Model Performance Using a Non-oversampled Validation Set.

Total Hours	**45**

Text Books:

1.	Jeffrey S. Strickland, “Predictive Analytics using R”, Lulu Publications, ISBN 978-1-312-84101-7, 2017.

2.	Galit Shmueli, Peter C. Bruce, Inbal Yahav, Nitin R. Patel, Kenneth C. Lichtendahl, “Data mining for Business Analytic: Concepts, Techniques, And Applications In R”, Wiley Publications, 2018.
3.	Daniel T. Larose, Chantal D. Larose, “Data Mining and Predictive Analytic”, Wiley, 2nd Edition 2015.
4.	Dr. Anasse Bari, Mohamed Chaouchi, Tommy Jung, “Predictive Analytics For Dummies”, Wiley, 2nd Edition, 2016.
5.	Richard Hurley, “Predictive Analytics: The Secret to Predicting Future Events Using Big Data and Data Science Techniques Such as Data Mining, Predictive Modelling, Statistics, Data Analysis, and Machine Learning”, 10th Edition, Ationa Publications 2019.
Reference Books:	
1.	Dinov Ivo D., “Data Science and Predictive Analytics”, Springer International Publishing AG, 5th Edition, 2018.
2.	Tamhane Ajit C, “Predictive Analytics- Parametric Models for Regression and Classification Using R”, John Wiley & Sons Inc, 1st Edition, 2020.
3.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, “Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies”, The MIT Press, 1st Edition, 2015.
4.	G.James, D.Witten, T.Hastie, R.Tibshirani, “An introduction to statistical learning with applications in R” ,Springer,2013.
Web References:	
1.	https://www.ibm.com/in-en/analytics/predictive-analytics
2.	https://cloud.google.com/learn/what-is-predictive-analytics
3.	https://www.sas.com/en_in/insights/analytics/predictive-analytics.html
4.	https://www.mathworks.com/discovery/predictive-analytics.html
Online Resources:	
1.	https://www.edx.org/course/introduction-to-analytics-modeling
2.	https://www.ey.com/en_in/ey-faas-learning-solutions/certificate-in-predictive-analytics-in-python
3.	https://www.skillsoft.com/channel/predictive-analytics-84e64131-1557-11e7-9f21-659139b59eba
4.	https://intellipaat.com/data-analytics-master-training-course

Continuous Assessment				**End Semester Examination**	**Total**
Formative Assessment	**Summative Assessment**	**Total**	**Total Continuous Assessment**		
80	**120**	**200**	**40**	**60**	**100**

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative Assessment based on Capstone Model			
Course Outcome	**Bloom's Level**	**Assessment Component (Choose and map components from the list - Quiz, Assignment, Case Study, Seminar, Group Assignment)**	**FA (16%) [80 Marks]**
C013.1	Understand	Quiz	20
C013.2	Remember	Tutorial	20
C013.3	Apply	Assignment	20
C013.4	Apply		
C013.5	Analyze	Presentation	20

Assessment based on Summative and End Semester Examination			
Bloom's Level	**Summative Assessment (24%) [120 Marks]**		**End Semester Examination (60%) [100 Marks]**
	CIA1: [60 Marks]	**CIA2: [60 Marks]**	
Remember	20	20	20
Understand	30	30	30
Apply	20	20	20
Analyse	30	30	30
Evaluate	-	-	-
Create	-	-	-

Assessment based on Continuous and End Semester Examination						
Continuous Assessment (40%) [200 Marks]						**End Semester Examination (60%) [100 Marks]**
CA 1: 100 Marks			**CA 2: 100 Marks**			
SA 1 (60 Marks)	**FA 1 (40 Marks)**		**SA 2 (60 Marks)**	**FA 2 (40 Marks)**		
	Component - I (20 Marks)	**Component - II (20 Marks)**		**Component - I (20 Marks)**	**Component - II (20 Marks)**	

Course Outcomes (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C013.1	2	3	1		1								1	2	2
C013.2	1	2	2		2								2	1	1
C013.3	3	3	3	3	3								3	3	1
C013.4	1	1	2		1								1	1	1
C013.5	2	1	2	2	1								2	1	2

21MC101	INDUCTION PROGRAMME	1/0/0/0
Nature of Course	Induction Programme	
Pre requisites	Nil	

Course Objectives:

1.	To have broad understanding of society and relationships
2.	To nurture the character and fulfil one's responsibility as an engineer, a citizen and a human being
3.	To incorporate meta skills and values

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Explore academic interest and activities	[AP]
C101.2	Work for excellence	[AP]
C101.3	Promote bonding and give a broader view of life and character	[AP]

Course Contents:

PHYSICAL ACTIVITY: Research over the past years has shown Yoga to have stress-relieving powers on students, paving the way for improved academic performance with the practice of asanas, meditation and breathing exercises. To prove these words Yoga classes has been planned in this module.(CO mapping: C101.1, C101.2, C101.3)

CREATIVE ARTS (students can select any one of their choice): Cultural development supports students to understand, feel comfortable with, value and appreciate the potential enrichment of cultural diversity. They should challenge discrimination, whether based on cultural or racial difference. Students should experience cultural traditions embedded in arts, crafts, language, literature, theatre, song, music, dance, sport, Science, technology and travel. Students should develop an appreciation of beauty both in experiencing artistic expression and by exploring their own creative powers. To inculcate those skills they are given a chance to exhibit their talents through painting, sculpture, pottery, music, dance, craft making and so on. .(CO mapping: C101.1, C101.2, C101.3)

UNIVERSAL HUMAN VALUES: Moral development involves supporting students to make considered choices around their behaviour and the values that provide a framework for how they choose to live. Moral development is also learning about society's

values, understanding the reasons for them, how they are derived and change; and how disagreements are resolved.Students must consider the consequences of personal and societal decisions on the wider community – local and global- and on the environment and future generations. To acquire thisthe students are exposed to training to enhance their soft skills. .(CO mapping: C101.1, C101.2, C101.3)

LITERARY AND PROFICIENCY MODULES: Social development helps students to work effectively together, developing the inter-personal skills required to relate positively with theirpeers and people of all ages. Students must also understand how to participate productively in a diverse and plural society and learn about, and how to effectively engage with societal institutions and processes. They should understand that a person may have different roles and responsibilities within society. To reach this the following aspects are given in the form ofReading, writing, speaking – debate, role play etc.Communication and computer skills. (CO mapping: C101.1, C101.2, C101.3)

LECTURES BY EMINENT PEOPLE: Teaching with Lectures It is essential to see lectures

as a means of helping students learn to think about the key concepts of a particular subject, rather than primarily as a means of transferring knowledge from instructor to student. During the induction period students will attend to Guest lectures by subject experts.(CO mapping: C101.1, C101.2, C101.3)

VISIT TO LOCAL AREAS: Traveling is in fact a way of learning to learn. You are out of yourcomfort zone and so you must learn to be able to adapt to a new learning environment in a very short time. It also helps in your overall learning as well. In the induction period students will be taken to different places near college to learn new things. Eg. Meditation centre

/orphanage/Hospital. (CO mapping: C101.1, C101.2, C101.3)

FAMILIARIZATION TO DEPARTMENT/BRANCH INNOVATION: Hod's of different brancheswill present about their department followed by department visit to view various facilities available at their department, new innovations from students and faculties etc.(CO mapping: C101.1, C101.2, C101.3)

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C101.1						3	3	3	3	3	3	3			1
C101.2						3	3	3	3	3	3	3			1
C101.3						3	3	3	3	3	3	3			1

21MC102	ENVIRONMENTAL SCIENCES	2/0/0/0

Nature of Course	Theory Concept
Pre requisites	Basics in Environmental Studies

Course Objectives:

1	To learn the integrated themes on various natural resources.
2	To gain knowledge on the type of pollution and its control methods.
3	To have an awareness about the current environmental issues and the social problems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall and play an important role in transferring a healthy environment for future generation.	[R]
C102.2	Understand the importance of natural resources and conservation of biodiversity.	[U]
C102.3	Understand and analyze the impact of engineering solutions in a global and societal context.	[U]
C102.4	Apply the gained knowledge to overcome pollution problems.	[AP]
C102.5	Apply the gained knowledge in various environmental issues and sustainable development.	[AP]

Course Contents:

Module 1: Natural Resources **10 Hours**

Introduction-Forest resources: Use and abuse, case study-Major activities in forest-Water resources-over utilization of water, dams-benefits and problems. Mineral resources-Use and exploitation, environmental effects of mining- case study–Food resources- World food problems, case study. Energy resources -Renewable and non-renewable energy sources Land resources- Soil erosion and desertification – Role of an individual in conservation of natural resources.

Module 2: Environmental Pollutions **10 Hours**

Definition – causes, effects and control measures of: a. Air pollution-Acid rain - Green house effect-Global warming- Ozone layer depletion – case study- Bhopal gas tragedyb. Water pollution c. Solid waste management-Recycling of plastics-Pyrolysis method- causes, effects and control measures of municipal solid wastes d. Noise pollution. e. Nuclear hazards-case study-Chernobyl nuclear disaster-Role of an individual in prevention of pollution.

Module 3: Social issues and the Environment	**10 Hours**
Sustainable development-water conservation, rain water harvesting, E-Waste Management – Environmental ethics: 12 Principles of green chemistry-Scheme of labelling of environmental friendly products (Eco mark) – Emission standards – ISO 14001 standard. HIV AIDS.	
Total Hours:	**30**

Text Books:	
1	Anubha Kaushik and C P Kaushik “Perspectives in Environmental Studies” 4th Edition, New age International (P) Limited, Publisher Reprint 2014. New Delhi
2	Rajagopalan, R, “Environmental Studies-From Crisis to Cure”, Oxford University Press 2015.

Reference Books:	
1	Tyler Miller, Jr, “Environmental Science”, Brooks/Cole a part of Cengage Learning, 2014.
2	William Cunningham and Mary Cunningham, “Environmental Science”, 13th Edition, McGraw Hill,2015.
3	Gilbert M. Masters, “Introduction to Environmental Engineering and Science”, Third Edition, Pearson Education, 2014.

Web References:	
1	http://nptel.ac.in/courses/104103020/20
2	http://nptel.ac.in/courses/120108002
3	http://nptel.ac.in/courses/122106030
5	http://nptel.ac.in/courses/122102006/20

Online Resources:	
1	https://www.edx.org/course/subject/environmental-studies
2	www.environmentalscience.org

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C102.1	Remember	Quiz	**5**
C102.2	Understand	Mini project based on environmental aspect	**15**
C102.3	Understand	Class Presentation	**10**
C102.4 C102.5	Apply	Group Assignment	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom's Level	**Term End Assessment [100 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C102.1						2	2						2		
C102.2						2	2						2		
C102.3						2	2							2	
C102.4						3	3						2		
C102.5						3	3						2		

21MC103	SOFT SKILLS	2/0/0/0
Nature of Course:	Theory Concept	
Pre requisites:	Technical Communication Skills	
Course Objectives:		
1.	To develop the students competency level and their capabilities.	
2.	To teach the students to be effective in workplace and social environments.	
3.	To create self confidence among the students and to resolve stress and conflict within themselves.	
4.	To help the students to enhance their career skills by increasing their productivity and performances.	
5.	To concentrate more on conversation skills, presentation skills, verbal ability, critical and creative thinking.	
Course Outcomes: **Upon completion of the course, students shall have ability to**		
C103.1	Remember the principles of soft skills required for their profession.	[R]
C103.2	Understand the importance of Interpersonal communication Skills among individuals, groups and cultures.	[U]
C103.3	Apply verbal and non-verbal communication skills in corporate environment.	[AP]
C103.4	Analyse and apply creativity skills, critical thinking skills and problem solving skills.	[AN]
C103.5	Articulate oral and written messages in an appropriate and persuasive manner to suit specific purposes, audiences and contexts at work place.	[AP]
C103.6	Apply good teamwork skills and Leadership Skills	[AP]

Module 1: Professional Communication Skills **10 Hours**

Introduction to the Soft Skills, Performance Evaluation 1 –Significance of Soft Skills- Understanding the basic Communication Principles –Listening Skills- Listening Exercises- Speaking Skills- How to start and Sustain a Conversation- Speaking in Groups- Understanding self and Personal Branding, attitude, types of attitude, Positive Attitude, Self Confidence and Self-Motivation - Personal Application/Action Taken. Advanced Writing Skills-Principles of Business Writing- E mails- Writing Reports- Types of Reports- Strategies for Report Writing- Personal Application/Action Taken. Verbal Ability- Analogy- Classification- Odd One Out-

Idioms and Phrases- Sentence Correction- Empathy and its importance in career -Personal Application/Action Taken.

Module 2: Interpersonal Communication **10 Hours**

Nonverbal Communication- Individual, Groups and Cultures- Body Language- Attire and Etiquettes- Interpersonal Skills- dealing with diverse People- Networking- Emotional Intelligence and its importance. Personal Application/Action Taken. Developing Creativity- Critical Thinking and Problem Solving Skills- Making the Right Choice- Never Give Up- Begin to Grow- Personal Application/Action Taken. Interviews- Facing Job Interviews - Planning and Preparing- Effective Resume along with Covering Letter- Planning and Preparing- Personal Application/Action Taken. Self-Discipline - Self Presentation - Personal Application/Action Taken.

Module 3: Teamwork and Leadership Skills **10 Hours**

Industry Expectations- Universal Hiring Rule- Personal Application/Action Taken. Importance of Human Values-Importance of Team Work- Developing Key Traits in Motivation, Persuasion, Negotiation and Leadership Skills- Being an Effective Team Player- Personal Application/Action Taken. Planning- Prioritization - Delegation- Conflict Management- Decision and its necessity in crucial situations- Group Discussion- Personal Application/Action Taken. Essential Skills in working Strategies- Presentation and Interaction Skills- What to Present and How- Being Assertive- Multimedia Presentation-Making Effective Presentations. Interview Skills- Do's and Don'ts - Body Language – Answering the Common Questions of Interview- Performance Evaluation 2- Mock Interview

Total Hours:	**30**

Text Books:

1.	Penrose, "Business Communication for managers: An advanced approach", Cengage learning.
2.	H.E. Sales, "Professional Communication in Engineering", Palgrave Macmillan 2009.
3.	W. P. Scott, Bertil Billing, "Communication for Professional Engineers", Thomas Telford, 1998.

Reference Books:

1.	Peter Davson-Galle, "Reason and Professional Ethics", Ashgate Publishing, Ltd., 2009.

3.	Joep Cornelissen, “Corporate Communications: Theory and Practice”, Sage Publications India Pvt Ltd, New Delhi, 2004.
Web References:	
1	https://onlinecourses.nptel.ac.in/noc16_hs15/preview
2	https://www.getinternship.switchidea.com/NTAT/syllabus/Interpersonal-Communication.
3	https://smude.edu.in/smude/programs/bca/soft-skills.html
Online Resources:	
1	https://swayam.gov.in/course/4047-developing-soft-skills-and-personality
2	https://www.clearias.com/interpersonal-skills-including-communication-skills-for-csat/
3	https://www.bizlibrary.com/soft-skills-training/

Assessment Methods & Levels (based on Revised Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:40)			
Course Outcome	**Revised Bloom’s Level**	**Assessment Component**	**Marks**
C103.1	Remember	Group Discussion	10
C103.2 & C103.3	Understand	Listening Skills	10
C103.4	Apply	Interview	10
C103.5 & C103.6	Apply	Formal Presentation	10

Revised Bloom’s Level	**Tentative End Assessment Examination (Theory) [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C103.1						1	1	2	2	3	2	2			1
C103.2							1	1	3	3	2	2			1
C103.3									2	3	2	2			1
C103.4						1	1	1	2	3	3	2			1
C103.5						1	1		2	3	2	2			1
C103.6							1	2	3	3	2	2			1

21MC105	GENERAL APTITUDE	2/0/0/0
Nature of Course	Problem analytical	
Pre requisites	Basic Mathematical calculations	

Course Objectives:

1	To ensure that students learn to think critically about mathematical models for relationships between different quantities and use those models effectively to solve problems and reach conclusions about them.
2	To impart skills that enable students to effectively use and interpret data, formulas, and graphs in the workplace.
3	To instills confidence in facing technical aptitude questions interviewed by recruiters.

Course Outcomes:

Upon completion of the course, students shall have ability to

C105.1	To teach the basics of Quantitative Techniques in a graded manner.	[R]
C105.2	Understand the verbal and non-verbal nature of problems in reality and know the shortcut methods of solving it.	[U]
C105.3	Solve problems using their general mental ability.	[AP]
C105.4	To give intense focus on improving and increasing the ability of solving real problems.	[AP]
C105.5	Think critically about mathematical models for relating different quantities to reach conclusion.	[AP]
C105.6	Enable effective use of data interpretation, formulas, graphs and assumptions.	[AP]

Module 1: Number Theory and Statistics **14 Hours**

Number Systems– HCF and LCM of Numbers – Decimal Fractions – Simplification – Square Root and Cube Root of a number – Surds and Indices – Problems on numbers – Percentage – Ratio and Proportion – Divisibility – Mixtures – Averages- Polynomials – Solving Equations and Inequalities – Discard's rule of signs – Problems on ages – Chain rule – Time and Work – Time and Distance – Problems on Trains – Problems on Boats andStreams- Measures of central tendency – Mean, Median and Mode – Variance and Standard deviation Logarithms – Profit and Loss – Simple Interest – Compound Interest.

Module 2: Logic and Decision Making **8 Hours**Analogy – Classification – Series completion – Coding and Decoding – Blood Relations – Puzzle Test – Direction Sense test – Logical Venn Diagrams - Number Ranking and Time

Sequence Test – Decision Making – Assertion and Reason– Inserting the missing one – Logical Sequence of words – Syllogisms.

Module 3: Reasoning **8 Hours**

Logic – Statement and Arguments – Statements and Assumptions – Statements and Course of Action – Statements and Conclusions – Deriving conclusions from passages – Functions – Different kinds of functions – Miscellaneous sets- Series – Analogy – Classifications – Analytical Reasoning – Problems on Cubes and Dice – Mirror Images – Water Images – Rule Detection.

Total Hours:	**30**

Text Books:

1	Aggarwal R. S, "Quantitative Aptitude" Revised Edition, S. Chand Publication.
2	Abhijit Guha, "Quantitative Aptitude" 5th Edition, McGraw Hill Education.

Reference Books:

1	Edgar Thorpe "Mental Ability & Quantitative Aptitude" 3rd Edition, McGraw Hill Education.

Web References:

1	https://www.wiziq.com/tutorial/815468-quantitative-aptitude-reasoning-data-interpretation-video-lectures
2	https://learningpundits.com/contest?referrer=harsh.cse15@nituk.ac.in
3	https://nptel.ac.in/courses/114106041/8
4	https://nptel.ac.in/courses/111103020/2

Online Resources:

1	http://aptitudetraining.in/home/index.php
2	https://www.udemy.com/vedicmaths/
3	https://www.youtube.com/channel/UCtmn-DsF4BhPug-ff9LiDAA?disable_polymer=true

Tentative Assessment Methods & Levels (based on Revised Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Revised Bloom's Level	Assessment Component	Marks
C105.1	Remember	Classroom or Online Quiz	10

C105.2 & C105.3	Understand	Formal presentation	10

C105.4, C105.5 & C105.6	Apply	Formal interview tests	20

Summative assessment based on Continuous and End Semester Examination	
Bloom's Level	**Term End Assessment Examination (Theory) [60 marks]**
Remember	20
Understand	40
Apply	40
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	**Programme Outcomes (PO)**												**Programme Specific Outcomes(PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
C105.1	3	3	1												
C105.2	3	2	1												
C105.3	3	3	1												
C105.4	3	2	1										2		
C105.5	3	3	1										2		
C105.6	3	2	1										2		

21MC106	LIFE SKILLS AND ETHICS	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

Course Objectives:

1	To develop communication competence in prospective engineers.
2	To enable them to convey thoughts and ideas with clarity and focus.
3	To develop report writing skills.
4	To equip them to face interview & Group Discussion.
5	To inculcate critical thinking process.
6	To prepare them on problem solving skills.
7	To provide symbolic, verbal, and graphical interpretations of statements in a problem description.

Course Outcomes:

Upon completion of the course, students shall have ability to

C106.1	Define and identify different life skills required in personal and professional life.	[U]
C106.2	Develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.	[AP]
C106.3	Explain the basic mechanics of effective communication and demonstrate these through presentations.	[AN]
C106.4	Use appropriate thinking and problem-solving techniques to solve new problems.	[AP]
C106.5	Understand the basics of teamwork and leadership	[U]

Course Contents:

Communication Skill:

Introduction to Communication, The Process of Communication, Barriers to Communication, Listening Skills, Writing Skills, Technical Writing, Letter Writing, Job Application, Report Writing, Non-verbal Communication and Body Language, Interview Skills, Group Discussion, Presentation Skills, Technology-based Communication.

Critical Thinking & Problem Solving:

Creativity, Lateral thinking, Critical thinking, Multiple Intelligence, Problem Solving, Six thinking hats Mind Mapping & Analytical Thinking. Teamwork: Groups, Teams, Group Vs Teams, Team formation process, Stages of Group, Group Dynamics, Managing Team Performance & Team Conflicts.

Ethics, Moral & Professional Values:

Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE. **Leadership Skills:** Leadership, Levels of Leadership, Making of a leader, Types of leadership, Transactions Vs Transformational Leadership, VUCA Leaders, DART Leadership, Leadership Grid & leadership Formulation

Total Hours:	**30**

Reference Books:

1	Barun K. Mitra, "Personality Development & Soft Skills", First Edition, Oxford Publishers, 2011.
2	Kalyana, "Soft Skill for Managers", 1st Edition, Wiley Publishing Ltd, 2015.
3	Larry James, "The First Book of Life Skills", 1st Edition, Embassy Books, 2016
5	John C. Maxwell, "The 5 Levels of Leadership", Centre Street, A division of Hachette Book Group Inc, 2014.

Web References:

1	https://www.coursera.org/courses?query=ethics

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom's Level	Assessment Component	Marks
C106.1	Remember	Quiz	**5**
C106.2	Understand	Assignment	**15**
C106.3	Understand	Presentation	**10**
C106.4 C106.5	Apply	Group Discussion	**10**

Summative assessment based on Continuous Assessment

Revised Bloom's Level	Term End Assessment [60 marks]
Remember	30
Understand	40
Apply	30
Analyse	-

Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C106.1								1	2	1		2	1		
C106.2								1	2	1		2	1		
C106.3								2	2	3		1	1		
C106.4								1	1	1		1	3		
C106.5								1	3	2		2	1		

21MC107	STRESS MANAGEMENT	2/0/0/0
Nature of Course	Theory Concept	
Pre requisites	Nil	

Course Objectives:

1	Understand the basic principles of stress management
2	Recognize your stress triggers and how to manage them
3	Develop proactive responses to stressful situations
4	Use coping tips for managing stress both on and off the job
5	Learn to manage stress through diet, sleep and other lifestyle factors
6	Develop a long term action plan to minimize and better manage stress
7	Understand the basic principles of stress management

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Understand the basic principles of stress management	[U]
C107.2	Apply the concept of recognizing your stress triggers and find was to manage them.	[AP]
C107.3	Develop proactive responses to stressful situations	[AN]
C107.4	Develop a long term action plan to minimize and better manage stress	[AP]

Course Contents:

Scientific Foundations of Stress:

What is stress? – Sources of Stress – Types of Stress – Personality Factors and stress – Stress and the college student. Stress Psychophysiology: Stress and nervous system – Hypothalamic – Pituitary – Adrenal (HPA) Axis – Effect of Stress on Immune system – Health risk associated with chronic stress – Stress and Major Psychiatric disorders.

Developing Resilience to Stress:

Understanding you stress level – Role of personality pattern, Self-esteem, Locus of control – Role of Thoughts Beliefs and Emotions – I & II – Life situation Intrapersonal: (Assertiveness, Time Management).

Strategies for Relieving Stress:

Developing cognitive coping skills – Autogenic training, imagery and progressive relaxation – Other relaxation techniques – Exercise and Health – DIY strategies stress management.

Total Hours:	**30**

Reference Books:	
1	Jonathan C. Smith, “Stress Management: A Comprehensive Handbook of Techniques and Strategies”, 1st Edition, Springer Publishing Company, 2011.
2	Bob Stahl, Elisha Goldstein, Jon Kabat-Zinn, “A Mindfulness–based Stress Reduction Workbook”, 2nd Edition, New Harbinger Publications, 2019.
3	Ryan M. Niemiec, “The Strengths-based Workbook for Stress Relief”, 1st Edition, New Harbinger Publications, 2019.
Web References:	
1	https://thiswayup.org.au/courses/coping-with-stress-course/
2	https://www.classcentral.com/course/swayam-stress-management-14309

Assessment Methods & Levels (based on Bloom’s Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:40)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C107.1	Remember	Quiz	**10**
C107.2	Understand	Group Discussion	**10**
C107.3	Understand	Class Presentation	**10**
C107.4	Apply	Assignment	**10**

Summative assessment based on Continuous Assessment	
Revised Bloom’s Level	**Term End Assessment [60 marks]**
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes(PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C107.1								1	3			1	1		

C107.2								1	2	1		1	1		
C107.3								1	3	1		2	2		
C107.4								1	3	1		3	2		

21MC108	CONSTITUTION OF INDIA	2/0/0/0

Nature of Course : Theory

Pre Requisites : Nil

Course Objectives:

1	To familiarize with basic information about Indian constitution
2	To understand the fundamental rights and duties as citizens of India

Course Outcomes:

Upon completion of the course, students shall have ability to

C108.1	Explain the objectives of the Constitution of India and its formation	[U]
C108.2	Recall state and central policies (Union and State Executive), fundamental Rights and their duties.	[R]
C108.3	Make use of legal directions in developing solutions to societal issues	[AP]
C108.4	Utilized for competitive exams that requires knowledge of Indian Constitution	[AP]

Course Contents:

Module 1 **10 Hours**

Historical perspective, The making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights, Directive Principles of State Policy, Fundamental Duties, Citizenship Article 5-11.

Module 2 **10 Hours**

Federal structure, Powers of the Union and the states, Centre-State Relations, Union Executive – President, Prime Minister, Union Cabinet, Parliament, Supreme Court of India, State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Elections, Electoral Process, and Election Commission of India, Election Laws. Powers and Functions of Municipalities and Panchayat

Module 3 **10 Hours**

Amendments - Methods, Emergency Provisions, National Emergency, President Rule, Financial Emergency, Provisions for SC & ST, OBC, women, children and backward classes, Right to Property, Freedom of Trade and Commerce. Agricultural Law

Total Hours: 30

Text Books:

1	Dr. D. D. Basu, “Introduction to the Constitution of India”, LexisNexis, New Delhi, 22nd Edition, 2016.

2	“Bare act-constitution of India”, The universal Publications, LexisNexis 2020, New Delhi, India.

Reference Books:	
1	Subhash. C. Kashyap, “Our Constitution: An Introduction to India’s Constitution and Constitutional Law”, National Book Trust, India, 5th Edition, 2019.
2	M. Laxmikanth, “Constitution of India”, Cengage Learning India, 1st Edition 2018.
Web References:	
1	https://unacademy.com/course/the-indian-constitution/NSKQ8XXQ
2	https://unacademy.com/goal/upsc-civil-services-examination-ias-preparation/KSCGY

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C108.1	Remember	Test	10
C108.4	Understand	Quiz	10
C108.3	Apply	Presentation	10
C108.2	Apply	Group Assignment	10

Summative assessment based on Continuous Assessment

Revised Bloom’s Level	Term End Assessment [60 marks]
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C108.1						3	1	1	1			1	1	1	
C108.2						3	1	1	1			1	1	2	
C108.3						3	2	2	1			1	1	2	
C108.4						3	1	1	1			2	1	1	

21MC109	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	2/0/0/0
Nature of Course : Theory		
Pre Requisites : Nil		

Course Objectives:

1	To make understand the contribution of Indian mind in various fields.
2	To cultivate critical appreciation of the thought content and provide insights relevant for promoting cognitive ability, health, good governance, aesthetic appreciation and right values.

Course Outcomes:

Upon completion of the course, students shall have ability to

C109.1	Relate classical Indian traditions with contemporary traditions and culture.	[R]
C109.2	Outline the thoughts of Indians in different disciplines.	[U]
C109.3	Apply the knowledge to the present context.	[AP]
C109.4	Develop a better appreciation and understanding of Indian traditions.	[C]

Course Contents:

Indian Ethics: Individual and Social – Society state and Polity (Survey) - Education systems – Agriculture (Survey) – Early & Classical Architecture – Medieval & Colonial Architecture.

Astronomy in India – Martial Arts Traditions (Survey) - Indian Literatures - Indian Philosophical Systems - Indian Traditional Knowledge on Environmental Conservation

Ayurveda for Life, Health and Well-being - The Historical Evolution of Medical Tradition in Ancient India- Music in India - Classical & Folk

Total hours:	**30**

Text Books:

1	Kapil Kapoor and Michel Danino, “Knowledge Traditions and Practices of India”, Central Board of Secondary Education, 2017.
2	Yogesh Atal, “Indian Society: Continuity and Change”, Pearson Education India, 2016.

Reference Books:	
1	Douglas Osto, “An Indian Tantric Tradition and Its Modern Global Revival”, Routledge publications, 2020.
2	Rao C.N. Shankar, “Sociology: Principles of Sociology with an Introduction to Social Thoughts”, S Chand Publisher, 2019.
Web References:	
1	http://nopr.niscair.res.in/handle/123456789/43
2	https://nptel.ac.in/courses/109/104/109104102/

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:100)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C109.1	Remember	Quiz	10
C109.2	Understand	Group Assignment	10
C109.3	Apply	Presentation	10
C109.4	Create	Survey	10

Summative assessment based on Continuous Assessment

Revised Bloom’s Level	Term End Assessment [60 marks]
Remember	30
Understand	40
Apply	30
Analyse	-
Evaluate	-
Create	-

Course Outcome (CO)	Programme Outcomes (PO)												Programme Specific Outcomes (PSO)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
C109.1						2	1	1	1			2	3	1	
C109.2						2	1	1	2			1	2	1	
C109.3						1	1	1	1			1	1	1	
C109.4						2	1	1	2			2	1	1	