B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATION – 2021

CHOICE BASED CREDIT SYSTEM

I - VIII SEMESTERS CURRICULA AND SYLLABI

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Graduates to exploit the knowledge of basic science, mathematics, statistics, and data science to build systems that require management and analysis of large volumes of real time data.

PEO2: To enrich the graduates with technical and professional skills to apply the concept of Artificial Intelligence to develop elegant solutions for the complex problems in various domains.

PEO3: To enable the graduates to think logically, pursue lifelong learning, and pioneering research in the field of Artificial Intelligence and Data Science to create disruptive and sustainable solutions for the real world issues.

PEO4: To inculcate ethical attitude, social responsibilities, and soft skills to work as a team to solve social, business and environmental problems.

PROGRAM OUTCOMES (POs)

Engineering 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Understand, Analyze, evolve and develop AI based efficient domain specific processes for effective decision making in several domains such as business, IT and governance.

PSO2: Able to arrive at actionable foresight, insight, hindsight from data for solving business and engineering problems by applying mathematical, statistical and computational principles

PSO3: Create, select and apply the theoretical knowledge of AI and Data Analytics along with practical industrial tools and techniques to manage and solve societal problems.

MAPPING OF PROGRAM OUTCOMES (POs) WITH
PROGRAM EDUCATIONAL OBJECTIVES (PEOs) & PROGRAM SPECIFIC OUTCOMES (PSOs)

PROGRAM OUTCOMES (POs)	PROGRAM EDUCATIONAL OBJECTIVES (PEOs)				PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
PO1: Engineering knowledge	3	3	2	1	3	3	3
PO2: Problem analysis	2	2	2	1	3	3	3
PO3: Design/development of solutions	3	3	2	1	3	3	3
PO4: Conduct investigations of complex problems	3	3	3	1	3	3	3
PO5: Modern tool usage	2	3	2	1	2	3	3
PO6: The engineer and society	2	2	1	2	2	2	3
PO7: Environment and sustainability	2	2	2	3	2	2	3
PO8: Ethics	2	2	3	1	2	2	3
PO9: Individual and team work	2	3	3	3	2	2	2
PO10: Communication	2	2	3	2	2	2	2
PO11: Project management and finance	2	3	3	1	1	2	3
PO12: Life-long learning	3	3	3	2	2	2	2

MAPPING OF PSOs TO PEOs

PROGRAM SPECIFIC OUTCOMES (PSOs)	PROGRAM EDUCATIONAL OBJECTIVES (PEOs)			
	PEO1	PEO2	PEO3	PEO4
PSO1	2	2	3	2
PSO2	2	3	3	1
PSO3	3	3	3	2

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES (POs)

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	Communicative English								✓	✓	✓		✓	✓	✓	✓
	Engineering Mathematics - I	✓	✓	✓						✓				✓	✓	✓
	Engineering Physics	✓	✓	✓										✓	✓	✓
	Engineering Chemistry	✓	✓	✓										✓	✓	✓
	Problem Solving and Python Programming	✓	✓	✓										✓	✓	✓
	Engineering Graphics	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Python Programming Laboratory	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Physics and Chemistry Laboratory	✓	✓	✓					✓	✓	✓			✓	✓	✓
II	Professional English								✓	✓	✓		✓	✓	✓	✓
	Linear Algebra	✓	✓	✓						✓				✓	✓	✓
	Physics for Information Science	✓	✓	✓										✓	✓	✓
	Environmental Science and Engineering	✓	✓	✓				✓	✓	✓	✓		✓	✓	✓	✓
	Basic Electrical, Electronics and Measurement Engineering	✓	✓	✓										✓	✓	✓
	Programming in C	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Engineering Practice Laboratory	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
	Programming in C Laboratory	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
III	Probability and Statistics	✓	✓	✓	✓					✓	✓		✓	✓	✓	✓
	Computer Organization and Architecture	✓	✓	✓		✓								✓	✓	✓
	Data Structures	✓	✓	✓										✓	✓	✓
	Object Oriented Programming (Lab Integrated)	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Introduction to Artificial Intelligence	✓	✓	✓	✓	✓								✓	✓	✓
	Foundations of Data Science	✓	✓	✓		✓							✓	✓	✓	✓
	Data Structures Laboratory using Python	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓
	Artificial Intelligence Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
IV	Discrete Mathematics	✓	✓	✓	✓					✓			✓	✓	✓	✓
	Design and Analysis of Algorithms	✓	✓	✓	✓	✓				✓	✓		✓	✓	✓	✓
	Operating Systems	✓	✓	✓		✓								✓	✓	✓
	Database Design and Management (Lab Integrated)	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Foundations of Machine Learning	✓	✓	✓		✓							✓	✓	✓	✓
	Python Programming for Data Science	✓	✓	✓		✓							✓	✓	✓	✓
	Data Science Laboratory using Python	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓
	Machine Learning Laboratory	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓	✓
	Professional Skills Laboratory								✓	✓	✓		✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
V	Optimization in Data Analysis	✓	✓	✓		✓								✓	✓	✓
	Advanced Artificial Intelligence	✓	✓	✓		✓							✓	✓	✓	✓
	Data Mining	✓	✓	✓		✓								✓	✓	✓
	Exploratory Data Analysis	✓	✓	✓	✓	✓							✓	✓	✓	✓
	Data Preparation and Analysis Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Advanced Artificial Intelligence Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
VI	Modern Scripting Languages	✓	✓	✓		✓							✓	✓	✓	✓
	Computational Linguistics	✓	✓	✓		✓							✓	✓	✓	✓
	Data Visualization	✓	✓	✓		✓							✓	✓	✓	✓
	Data Analytics	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Data Visualization Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Mini Project - I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VII	Neuro-Fuzzy Computing	✓	✓	✓		✓							✓	✓	✓	✓
	Text Analytics	✓	✓	✓		✓							✓	✓	✓	✓
	Computer Vision	✓	✓	✓										✓	✓	✓
	Big Data Management	✓	✓	✓										✓	✓	✓
	Neuro-Fuzzy Computing Laboratory	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓	✓	✓
	Mini Project - II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
VIII	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MAPPING OF PROFESSIONAL ELECTIVES

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
V	XML and Web Services	✓	✓	✓		✓								✓	✓	✓
	R Programming for Data Science	✓	✓	✓	✓	✓								✓	✓	✓
	Prolog Programming for Artificial Intelligence	✓	✓	✓	✓	✓							✓	✓	✓	✓
	Knowledge Engineering	✓	✓	✓		✓							✓	✓	✓	✓
	Data Science Tools	✓	✓	✓	✓	✓							✓	✓	✓	✓
VI	Image and Video Analytics	✓	✓	✓		✓								✓	✓	✓
	Healthcare Analytics	✓	✓	✓										✓	✓	✓
	Cloud Computing for Data Analysis	✓	✓	✓		✓								✓	✓	✓
	Computational Thinking	✓	✓	✓					✓					✓	✓	✓
	Ethics in Data Science								✓	✓	✓		✓	✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
VII	Data and Information Security	✓	✓	✓										✓	✓	✓
	Evolutionary Computation	✓	✓	✓		✓								✓	✓	✓
	Pattern Recognition	✓	✓	✓		✓								✓	✓	✓
	Web Analytics	✓	✓	✓		✓								✓	✓	✓
	Principles of Management	✓	✓	✓						✓	✓			✓	✓	✓
	Stochastic Process	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓
	Software Testing using Automated Tools								✓	✓	✓			✓	✓	✓
	Multivariate Analysis	✓	✓	✓					✓	✓	✓			✓	✓	✓
	Social Network Analytics	✓	✓	✓										✓	✓	✓
	Entrepreneurship	✓	✓	✓										✓	✓	✓

SEM	COURSE TITLE	PROGRAM OUTCOMES (POs)												PSOs		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
VIII	Data Mining and Information Security								✓	✓	✓			✓	✓	✓
	Speech Processing and Synthesis	✓	✓	✓										✓	✓	✓
	Cyber Security	✓	✓	✓		✓								✓	✓	✓
	Predictive Analytics	✓	✓	✓					✓	✓	✓		✓	✓	✓	✓
	Statistical Computing	✓	✓	✓						✓	✓			✓	✓	✓
	Engineering Economics								✓	✓	✓			✓	✓	✓
	Cognitive Systems	✓	✓	✓					✓	✓	✓			✓	✓	✓
	Parallel Computing	✓	✓	✓										✓	✓	✓
	Bio-inspired Optimization Techniques	✓	✓	✓										✓	✓	✓
	Information Storage Management	✓	✓	✓										✓	✓	✓

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1101	Communicative English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1102	Engineering Mathematics – I **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	4	4	0	0	4
3	PH1103	Engineering Physics **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
4	CY1104	Engineering Chemistry **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	3	3	0	0	3
5	GE1105	Problem Solving and Python Programming **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	3	3	0	0	3
6	GE1106	Engineering Graphics **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	6	2	0	4	4
PRACTICAL								
7	GE1107	Python Programming Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
8	BS1108	Physics and Chemistry Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	BSC	4	0	0	4	2
Total				**30**	**18**	**0**	**12**	**24**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	HS1201	Professional English **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
2	MA1251	Linear Algebra **(Common to AI-DS & AI-ML)**	BSC	4	4	0	0	4
3	PH1252	Physics for Information Science **(Common to CSE, IT, AI-DS & AI-ML)**	BSC	3	3	0	0	3
4	GE1204	Environmental Science and Engineering **(Common to all Branches of B.E. / B. Tech Programmes)**	HSMC	3	3	0	0	3
5	BE1251	Basic Electrical, Electronics and Measurement Engineering **(Common to CSE, IT, AI-DS & AI-ML)**	ESC	3	3	0	0	3
6	CS1206	Programming in C **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	4	3	1	0	3
PRACTICAL								
7	GE1207	Engineering Practice Laboratory **(Common to all Branches of B.E. / B. Tech Programmes)**	ESC	4	0	0	4	2
8	CS1208	Programming in C Laboratory **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	4	0	0	4	2
Total				**28**	**19**	**1**	**8**	**23**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1351	Probability and Statistics **(Common to CSE, IT & AI-DS)**	BSC	4	4	0	0	4
2	DS1301	Computer Organization and Architecture	ESC	3	3	0	0	3
3	CS1302	Data Structures **(Common to CSE, IT,AI-DS, AI-ML & ECE Semester IV)**	PCC	4	3	1	0	3
4	DS1302	Object Oriented Programming (Lab Integrated) **(Common to AI-DS, EEE & EIE)**	PCC	5	3	0	2	4
5	DS1303	Introduction to Artificial Intelligence **(Common to AI-DS & AI-ML)**	PCC	3	3	0	0	3
6	DS1304	Foundations of Data Science	PCC	3	3	0	0	3
PRACTICAL								
7	DS1307	Data Structures Laboratory using Python **(Common to AI-DS & AI-ML)**	PCC	4	0	0	4	2
8	DS1308	Artificial Intelligence Laboratory **(Common to AI-DS & AI-ML)**	PCC	4	0	0	4	2
Total				**30**	**19**	**1**	**10**	**24**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA1453	Discrete Mathematics **(Common to CSE, IT & AI-DS)**	BSC	4	4	0	0	4
2	CS1401	Design and Analysis of Algorithms **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
3	CS1402	Operating Systems **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
4	CS1403	Database Design and Management (Lab Integrated) **(Common to CSE, IT, AI-DS & AI-ML)**	PCC	5	3	0	2	4
5	DS1401	Python Programming for Data Science	PCC	3	3	0	0	3
6	ML1401	Foundations of Machine Learning **(Common to IT, AI-DS & AI-ML)**	PCC	3	3	0	0	3
PRACTICAL								
7	DS1407	Data Science Laboratory using Python	PCC	4	0	0	4	2
8	ML1408	Machine Learning Laboratory **(Common to IT, AI-DS & AI-ML)**	PCC	4	0	0	4	2
9	HS1310	Professional Skills Laboratory	HSMC	2	0	0	2	1
Total				**31**	**19**	**0**	**12**	**25**

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	DS1501	Optimization in Data Analysis	PCC	4	4	0	0	4
2	DS1502	Advanced Artificial Intelligence **(Common to AI-DS & AI-ML)**	PCC	4	3	1	0	3
3	DS1503	Data Mining	PCC	4	3	1	0	3
4	DS1504	Exploratory Data Analysis	PCC	4	3	1	0	3
5		Open Electives - I	OEC	3	3	0	0	3
6		Professional Elective - I	PEC	3	3	0	0	3
PRACTICAL								
7	DS1507	Data Preparation and Analysis Laboratory	PCC	4	0	0	4	2
8	DS1508	Advanced Artificial Intelligence Laboratory **(Common to IT, AI-DS & AI-ML)**	PCC	4	0	0	4	2
Total				**30**	**19**	**3**	**8**	**23**
9		Value Added Courses	Audit Course	Two Weeks				1

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	DS1601	Modern Scripting Languages	PCC	4	3	1	0	3
2	DS1602	Computational Linguistics	PCC	4	3	1	0	3
3	DS1603	Data Visualization	PCC	3	3	0	0	3
4	DS1604	Data Analytics	PCC	5	3	0	2	4
5		Open Elective - II	OEC	3	3	0	0	3
6		Professional Electives - II	PEC	3	3	0	0	3
PRACTICAL								
7	DS1607	Data Visualization Laboratory	PCC	4	0	0	4	2
8	DS1608	Mini Project - I	EEC	4	0	0	4	2
Total				**30**	**18**	**2**	**10**	**23**
9		Audit Course (Optional)	AC					

SEMESTER VII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	DS1701	Neuro-Fuzzy Computing	PCC	4	3	1	0	3
2	DS1702	Text Analytics	PCC	4	3	1	0	3
3	DS1703	Computer Vision	PCC	4	3	1	0	3
4	DS1704	Big Data Management	PCC	4	3	1	0	3
5		Professional Elective - III	PEC	3	3	0	0	3
6		Professional Elective - IV	PEC	3	3	0	0	3
PRACTICAL								
7	DS1707	Neuro-Fuzzy Computing Laboratory	PCC	4	0	0	4	2
8	DS1708	Mini Project - II	EEC	4	0	0	4	2
Total				**30**	**18**	**4**	**8**	**22**

SEMESTER VIII

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective - V	PEC	3	3	0	0	3
2		Professional Elective - VI	PEC	3	3	0	0	3
PRACTICAL								
3	DS1807	Project Work	EEC	20	0	0	20	10
Total				**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 180

HUMANITICS SCIENCE AND MANAGEMENT COURSES (HSMC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	HS1101	Communicative English	3	3	0	0	3
2	HS1201	Professional English	3	3	0	0	3
3	GE1204	Environmental Science and Engineering	3	3	0	0	3
4	HS1310	Professional Skills Laboratory	2	0	0	2	1

BASIC SCIENCE COURSES (BSC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	MA1102	Engineering Mathematics - I	4	4	0	0	4
2	PH1103	Engineering Physics	3	3	0	0	3
3	CY1104	Engineering Chemistry	3	3	0	0	3
4	BS1108	Physics and Chemistry Laboratory	4	0	0	4	2
5	MA1251	Linear Algebra	4	4	0	0	4
6	PH1252	Physics for Information Science	3	3	0	0	3
7	MA1351	Probability and Statistics	4	4	0	0	4
8	MA1453	Discrete Mathematics	4	4	0	0	4

ENGINEERING SCIENCE COURSES (ESC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	GE1105	Problem Solving and Python Programming	3	3	0	0	3
2	GE1106	Engineering Graphics	6	2	0	4	4
3	GE1107	Python Programming Laboratory	4	0	0	4	2
4	BE1251	Basic Electrical, Electronics and Measurement Engineering	3	3	0	0	3
5	GE1207	Engineering Practice Laboratory	4	0	0	4	2
6	DS1301	Computer Organization and Architecture	3	3	0	0	3

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	CS1206	Programming in C	4	3	1	0	3
2	CS1208	Programming in C Laboratory	4	0	0	4	2
3	CS1302	Data Structures	4	3	1	0	3
4	DS1302	Object Oriented Programming (Lab Integrated)	5	3	0	2	4
5	DS1303	Introduction to Artificial Intelligence	3	3	0	0	3
6	DS1304	Foundations of Data Science	3	3	0	0	3
7	DS1307	Data Structure Laboratory using Python	4	0	0	4	2
8	DS1308	Artificial Intelligence Laboratory	4	0	0	4	2
9	CS1401	Design and Analysis of Algorithms	3	3	0	0	3
10	CS1402	Operating Systems	3	3	0	0	3
11	CS1403	Database Design and Management (Lab Integrated)	5	3	0	2	4
12	ML1401	Foundations of Machine Learning	3	3	0	0	3
13	DS1401	Python Programming for Data Science	3	3	0	0	3
14	DS1407	Data Science Laboratory using Python	4	0	0	4	2
15	ML1408	Machine Learning Laboratory	4	0	0	4	2
16	DS1501	Optimization in Data Analysis	4	4	0	0	4
17	DS1502	Advanced Artificial Intelligence	4	3	1	0	3
18	DS1503	Data Mining	4	3	1	0	3
19	DS1504	Exploratory Data Analysis	4	3	1	0	3
20	DS1507	Data Preparation and Analysis Laboratory	4	0	0	4	2
21	DS1508	Advanced Artificial Intelligence Laboratory	4	0	0	4	2
22	DS1601	Modern Scripting Languages	4	3	1	0	3
23	DS1602	Computational Linguistics	4	3	1	0	3
24	DS1603	Data Visualization	3	3	0	0	3
25	DS1604	Data Analytics	5	3	0	2	4
26	DS1607	Data Visualization Laboratory	4	0	0	4	2
27	DS1701	Neuro-Fuzzy Computing	4	3	1	0	3
28	DS1702	Text Analytics	4	3	1	0	3
29	DS1703	Computer Vision	4	3	1	0	3
30	DS1704	Big Data Management	4	3	1	0	3
31	DS1707	Neuro-Fuzzy Computing Laboratory	4	0	0	4	2

PROFESSIONAL ELECTIVE COURSES (PEC)

SEMESTER V

PROFESSIONAL ELECTIVE - I

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1511	XML and Web Services	3	3	0	0	3
2	DS1512	R Programming for Data Science	3	3	0	0	3
3	DS1513	Prolog Programming for Artificial Intelligence	3	3	0	0	3
4	DS1514	Data Science Tools	3	3	0	0	3
5	IT1514	Knowledge Engineering	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE - II

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1611	Image and Video Analytics	3	3	0	0	3
2	DS1612	Healthcare Analytics	3	3	0	0	3
3	DS1613	Cloud Computing for Data Analysis	3	3	0	0	3
4	DS1614	Computational Thinking	3	3	0	0	3
5	DS1615	Ethics in Data Science	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE - III

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1711	Data and Information Security	3	3	0	0	3
2	DS1712	Evolutionary Computation	3	3	0	0	3
3	DS1713	Pattern Recognition	3	3	0	0	3
4	DS1714	Web Analytics	3	3	0	0	3
5	MG1001	Principles of Management	3	3	0	0	3

SEMESTER VII

PROFESSIONAL ELECTIVE - IV

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1721	Stochastic Process	3	3	0	0	3
2	DS1722	Software Testing using Automated Tools	3	3	0	0	3
3	DS1723	Social Network Analytics	3	3	0	0	3
4	DS1724	Multivariate Analysis	3	3	0	0	3
5	MG1725	Entrepreneurship	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE - V

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1811	Data Mining and Information Security	3	3	0	0	3
2	DS1812	Speech Processing and Synthesis	3	3	0	0	3
3	DS1813	Cyber Security	3	3	0	0	3
4	DS1814	Predictive Analytics	3	3	0	0	3
5	DS1815	Statistical Computing	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE - VI

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1821	Cognitive Systems	3	3	0	0	3
2	DS1822	Parallel Computing	3	3	0	0	3
3	DS1823	Bio-inspired Optimization Techniques	3	3	0	0	3
4	DS1824	Information Storage Management	3	3	0	0	3
5	MG1825	Engineering Economics	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	DS1608	Mini Project – I	4	0	0	4	2
2	DS1708	Mini Project - II	4	0	0	4	2
3	DS1807	Project Work	20	0	0	20	10

OPEN ELECTIVE COURSES – I & II

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	OBT101	Industrial Biotechnology	3	3	0	0	3
2	OBT104	Bio Sensors	3	3	0	0	3
3	OBT105	Introduction to Nano Science and Nano Technology	3	3	0	0	3
4	OCE102	Introduction to Geographic Information system	3	3	0	0	3
5	OCH101	Hospital Management	3	3	0	0	3
6	OEC103	Basics of Embedded Systems and IoT	3	3	0	0	3
7	OEE101	Basic Circuit Theory	3	3	0	0	3
8	OEE103	Introduction to Renewable Energy Systems	3	3	0	0	3
9	OEI102	Robotics	3	3	0	0	3
10	OMB101	Total Quality Management	3	3	0	0	3
11	OME104	Industrial Safety Engineering	3	3	0	0	3

AUDIT COURSE (AC)

S.No.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1	AD1001	Constitution of India	2	2	0	0	0
2	AD1002	Value Education	2	2	0	0	0
3	AD1003	Pedagogy Studies	2	2	0	0	0
4	AD1004	Stress Management by Yoga	2	2	0	0	0
5	AD1005	Personality Development Through Life EnlightenmentSkills	2	2	0	0	0
6	AD1006	Unnat Bharat Abhiyan	2	2	0	0	0
7	AD1007	Essence of Indian Knowledge Tradition	2	2	0	0	0
8	AD1008	Sanga Tamil LiteratureAppreciation	2	2	0	0	0

* Registration for any of these courses is optional to students

CREDIT SUMMARY

S. No.	SUBJECT AREA	I	II	III	IV	V	VI	VII	VIII	TOTAL	PERCENTAGE OF CREDIT
1	**HSMC**	3	6		1					**10**	**5.56**
2	**BSC**	12	7	4	4					**27**	**15.00**
3	**ESC**	9	5	3						**17**	**9.44**
4	**PCC**		5	17	20	17	15	14		**88**	**48.89**
5	**PEC**					3	3	6	6	**18**	**10.00**
6	**OEC**					3	3			**6**	**3.33**
7	**EEC**						2	2	10	**14**	**7.78**
TOTAL		**24**	**23**	**24**	**25**	**23**	**22**	**22**	**16**	**180**	**100**

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	Common for all Branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills.

UNIT I	SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS	9
Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh- Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development-- prefixes- suffixes- articles - Polite Expressions.		CO1
UNIT II	**GENERAL READING AND FREE WRITING**	**9**
Reading: Short narratives and descriptions from newspapers (including dialogues and conversations; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening **-** long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.		CO2
UNIT III	**GRAMMAR AND LANGUAGE DEVELOPMENT**	**9**
Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.		CO3
UNIT IV	**READING AND LANGUAGE DEVELOPMENT**	**9**
Reading- comprehension-reading longer texts- reading different types of texts- magazines. Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening: Listening comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous- conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms- Single word substitutes- Collocations.		CO4
UNIT V	**EXTENDED WRITING**	**9**
Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- Listening **-** popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Board of Editors. Using English, A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	4	0	0	4

OBJECTIVES

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms		CO1
UNIT II	**CALCULUS OF ONE VARIABLE**	**12**
Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.		CO2
UNIT III	**CALCULUS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler‘s theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor‘s series for functions of two variables – Maxima and minima of functions of two variables – Lagrange‘s method of undetermined multipliers.		CO3
UNIT IV	**INTEGRAL CALCULUS**	**12**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals.		CO4
UNIT V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematicsǁ, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., —Advanced Engineering Mathematics‖, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., —Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	3	-	-	3	2	3	3	3	3	2
CO2	3	3	3	2	2	1	-	-	-	-	1	2	3	3	2
CO3	3	3	3	2	2	1	-	-	-	-	1	2	2	3	2
CO4	3	3	3	2	2	1	-	-	-	-	1	2	2	3	1
CO5	3	3	3	2	1	1	-	-	-	-	1	2	2	3	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

UNIT I	PROPERTIES OF MATTER	9
Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.		**CO1**

UNIT II	LASER AND FIBER OPTICS	9
Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.		**CO2**

UNIT III	THERMAL PHYSICS	9
Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity –Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace and solar water heaters.		**CO3**

UNIT IV	QUANTUM PHYSICS	9
Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.		**CO4**

UNIT V	CRYSTAL PHYSICS	9
Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2019.

REFERENCE BOOKS

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2019.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
CO5	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I	WATER AND ITS TREATMENT	9
Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.		CO1

UNIT II	SURFACE CHEMISTRY AND CATALYSIS	9
Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of adsorption in pollution abatement using PAC. **Catalysis**: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.		CO2

UNIT III	PHASE RULE AND ALLOYS	9
Phase rule: Introduction – Definition of terms with examples – One component system – Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process. **Alloys**: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.		CO3

UNIT IV	FUELS AND COMBUSTION	9
Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – Compressed natural gas (CNG) – Liquefied petroleum gases (LPG) – Power alcohol and biodiesel. **Combustion of fuels**: Introduction – Calorific value – Higher and lower calorific values – Theoretical calculation of calorific value – Ignition temperature – Spontaneous ignition temperature – Explosive range – Flue gas analysis by Orsat Method.		CO4

UNIT V	NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES	9
Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
2. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).
4. P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCE BOOKS

1. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).
3. Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).
4. Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).
5. A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media., New Delhi., (2010).
6. Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	1
CO2	3	3	2	2	2	2	2	1	1	1	1	2	2	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	3	1	2
CO5	3	2	3	3	3	3	3	2	2	2	2	2	3	2	3

GE1105	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

UNIT I	ALGORITHMIC PROBLEM SOLVING	9
Algorithms, Building blocks of algorithms: statements, state, control flow, functions, Notation: pseudo code, flow chart, programming language, Algorithmic problem solving: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, 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.		**CO1**

UNIT II	INTRODUCTION TO PYTHON	9
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		**CO2**

UNIT III	CONTROL FLOW, FUNCTIONS AND STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		**CO3**

UNIT IV	LISTS, TUPLES, DICTIONARIES	9
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		**CO4**

UNIT V	FILES, MODULES, PACKAGES	9
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		**CO5**

TOTAL : 45 PERIODS

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/thinkpython/)
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. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

GE1106	ENGINEERING GRAPHICS	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	2	0	4	4

OBJECTIVES

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination)		**1**
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.		
UNIT I	**PLANE CURVES AND FREEHAND SKETCHING**	**7+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects		**CO1**
UNIT II	**PROJECTION OF POINTS, LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal Planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		**CO2**
UNIT III	**PROJECTION OF SOLIDS**	**5+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		**CO3**
UNIT IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OFSURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		**CO4**
UNIT V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.		**CO5**
		TOTAL : 90 PERIODS

TEXT BOOKS

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2011.

REFERENCE BOOKS

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 53rd Edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2018.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Comput er Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)											PROGRAM SPECIFIC OUTCOMES (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	1	-	-	3	3	2	3	1	1	1
CO2	3	1	2	2	1	1	-	-	3	3	2	3	1	1	1
CO3	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO4	3	1	1	3	1	1	-	-	3	3	2	3	1	1	1
CO5	3	1	2	3	1	1	-	-	3	3	2	3	1	1	1

GE1107	PYTHON PROGRAMMING LABORATORY	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, and dictionaries.
- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. Write an algorithm and draw flowchart illustrating mail merge concept.	**CO1**
2. Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems	
3. Scientific problem-solving using decision making and looping. • Armstrong number, palindrome of a number, Perfect number.	
4. Simple programming for one dimensional and two-dimensional arrays. • Transpose, addition, multiplication, scalar, determinant of a matrix	
5. Program to explore string functions and recursive functions.	**CO2**
6. Utilizing 'Functions' in Python • Find mean, median, mode for the given set of numbers in a list. • Write a function dups to find all duplicates in the list. • Write a function unique to find all the unique elements of a list. • Write function to compute gcd, lcm of two numbers.	
7. Demonstrate the use of Dictionaries and tuples with sample programs.	
8. Implement Searching Operations: Linear and Binary Search.	
9. To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.	
10. Find the most frequent words in a text of file using command line arguments.	**CO3**
11. Demonstrate Exceptions in Python.	
12. Applications**:** Implementing GUI using turtle, pygame.	

TOTAL: 60 PERIODS

REFERENCE BOOKS

1. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019
2. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
3. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
4. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
5. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)

WEB REFERENCES	
1. http://www.edx.org	
COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Develop simple console applications through python with control structure and functions
CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Read and write data from/to files in Python and applications of python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

BS1108	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

The students will be trained to perform experiments to study the following.

- ❖ The Properties of Matter
- ❖ The Optical properties, Characteristics of Lasers & Optical Fibre
- ❖ Electrical & Thermal properties of Materials
- ❖ Enable the students to enhance accuracy in experimental measurements.
- ❖ To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- ❖ Instrumental method of analysis such as potentiometry, conductometry and pHmetry

LIST OF EXPERIMENTS – PHYSICS

(A minimum of 5 experiments to be performed from the given list)

1. Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	**CO1**
2. Determination of Young's modulus of the material of the given beam by uniform bending method.	
3. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	
4. Determination of wavelength of mercury spectra using Spectrometer and grating.	**CO2**
5. Determination of dispersive power of prism using Spectrometer.	
6. (a) Determination of wavelength and particle size using a laser. (b) Determination of Numerical and acceptance angle of an optical fibre.	
7. Determination of energy band gap of the semiconductor.	
8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc.	

DEMONSTRATION EXPERIMENT

1. Determination of thickness of a thin sheet / wire – Air wedge method	**CO1**

LIST OF EXPERIMENTS – CHEMISTRY

(A minimum of 6 experiments to be performed from the given list)

1. Determination of chloride content of water sample by argentometric method.	**CO3**
2. Estimation of copper content of the given solution by Iodometry.	
3. Determination of strength of given hydrochloric acid using pH meter.	
4. Determination of strength of acids in a mixture of acids using conductivity meter.	**CO4**
5. Estimation of iron content of the given solution using potentiometer.	
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.	
7. Conductometric titration of strong acid vs strong base.	
8. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.	**CO5**
9. Determination of total, temporary & permanent hardness of water by EDTA method.	
10. Determination of DO content of water sample by Winkler's method.	

DEMONSTRATION EXPERIMENTS	
1. Estimation of iron content of the water sample using spectrophotometer (1,10-Phenanthroline / thiocyanate method).	**CO3**
2. Estimation of sodium and potassium present in water using flame photometer.	**CO5**
TOTAL: 60 PERIODS	

REFERENCE BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2017.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2013.
4. P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).
5. S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	2
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	2	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	1	1

HS1201	PROFESSIONAL ENGLISH	L	T	P	C
	Common for all branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

The Course prepares second semester engineering and Technology students to:

- ❖ Develop strategies and skills to enhance their ability to read and comprehend Engineering and technology texts.
- ❖ Foster their ability to write convincing job applications and effective reports.
- ❖ Develop their speaking skills to make technical presentations, participate in group discussions.
- ❖ Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

UNIT I	INTRODUCTION TO PROFESSIONAL ENGLISH	9
Listening: Listening to technical talks with comprehension tasks - Speaking – conversation methods in real life occurrences using expressions of different emotions and imperative usages - Reading – reading short technical texts from journals- newspapers- Writing- purpose statements – extended definitions – writing instructions – checklists-recommendations- Vocabulary Development- technical vocabulary Language Development – tenses- subject verb agreement - compound words.		**CO1**

UNIT II	READING AND STUDY SKILLS	9
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		**CO2**

UNIT III	TECHNICAL WRITING AND GRAMMAR	9
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing- Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		**CO3**

UNIT IV	REPORT WRITING	9
Listening **–** Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - Writing- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays--Vocabulary Development- finding suitable synonyms-paraphrasing- Language Development- clauses- if conditionals.		**CO4**

UNIT V	GROUP DISCUSSION AND JOB APPLICATIONS	9
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking –participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020.
2. Barun K Mitra, Effective Technical Communication Oxford University Press : 2006.
3. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCE BOOKS

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.
6. Caroline Meyer & Bringi dev, Communicating for Results Oxford University Press: 2021.
7. Aruna Koneru, Professional Speaking Skills, Oxford University Press :2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	2	3	-	-	2	-	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	2	-	2
CO3	-	2	-	3	-	-	-	-	-	2	-	-	2	-	1
CO4	-	-	-	-	-	-	-	-	2	2	-	-	2	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	-	2

MA1251	LINEAR ALGEBRA	L	T	P	C
	Common for AI-DS and AI-ML	4	0	0	4

OBJECTIVES

- To test the consistency and solve the system of linear equations
- To find the basis and dimension of vector space
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors
- To find orthonormal basis of inner product space and find least square approximation
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

UNIT I	MATRICES AND SYSTEM OF LINEAR EQUATIONS	12
Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordon method.		CO1
UNIT II	**VECTOR SPACES**	**12**
Vector spaces, Subspaces, Linear combinations, Linear independence and linear dependence, Bases and dimensions.		CO2
UNIT III	**LINEAR TRANSFORMATION**	**12**
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation.		CO3
UNIT IV	**INNER PRODUCT SPACES**	**12**
INNER product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation		CO4
UNIT V	**EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION**	**12**
Eigen value Problems: Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Friedberg S.H, Insel A.J. and Spence L, Linear Algebra, Fifth edition, Pearson, 2018
2. Burden R. and Faires J.D. Numerical Analysis, tenth edition, Brooks/Cole, 2015.
3. Strang G, Linear algebra for everyone, Wellesley Cambridge press, 2020.

REFERENCE BOOKS

1. Seymour Libschutz and Marc Lipson, Linear Algebra, Sixth edition, McGraw Hill Education India private limited, New Delhi, 2017.
2. Iyengar S.R.K. and Jain R.K., Numerical Methods, Third edition, New age international publications, 2012.
3. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Bernard Kolman and David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, First Reprint, 2009.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Test the consistency and solve the system of linear equations
CO2	Find the basis and dimension of vector space
CO3	Obtain the matrix of linear transformation and its eigenvalues and eigenvectors
CO4	Find orthonormal basis of inner product space and find least square approximation
CO5	Determine eigen values of a matrix using numerical techniques and perform matrix decomposition

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	3	3	2	-	-	1	1	3	3	3	3
CO2	3	3	2	3	2	2	1	-	-	-	-	2	2	2	2
CO3	3	2	2	2	2	1	1	-	-	-	-	1	2	2	2
CO4	3	3	3	2	2	2	1	-	-	-	-	1	2	2	2
CO5	3	3	3	2	2	2	1	-	-	-	-	1	2	3	3

PH1252	PHYSICS FOR INFORMATION SCIENCE	L	T	P	C
	Common for CSE, IT, AI-DS and AI-ML	3	0	0	3

OBJECTIVES

- To acquire knowledge on the electron transport properties
- To understand the essential principles of semiconductor device
- To have the necessary understanding in optical properties of materials.
- To grasp the principles of magnetic materials and its applications.
- To understand the basics of Nano-electronic devices.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9
Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential - Energy bands in solids - Electron effective mass - concept of hole - Applications of low resistive and high resistive materials.		CO1

UNIT II	SEMICONDUCTOR PHYSICS	9
Intrinsic semiconductors - Energy band diagram - direct and indirect band gap semiconductors - carrier concentration in intrinsic semiconductors - extrinsic semiconductors - carrier concentration in n-type & p-type semiconductors - variation of carrier concentration with temperature - variation of Fermi level with temperature and impurity concentration - carrier transport in semiconductors - Hall effect and devices - Ohmic contacts – Schottky diode - Semiconducting polymers.		CO2

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9
Magnetism in materials - magnetic dipole moment - magnetic permeability and susceptibility - Microscopic classification of magnetic materials : diamagnetism - paramagnetism - ferromagnetism – antiferromagnetism - ferrimagnetism - Curie temperature - Domain Theory - M versus H behavior - Hard and soft magnetic materials - examples and uses - Magnetic principle in computer data storage - Magnetic hard disc - Spintronics - GMR Sensor (Giant Magnetoresistance) - TMR (Tunnel Magnetoresistance)		CO3

UNIT IV	OPTICAL PROPERTIES OF MATERIALS	9
Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - p-i-n Photodiodes - Avalanche Photodiodes -Optical data storage techniques- Holography - applications.		CO4

UNIT V	NANO DEVICES	9
Electron density in bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials - Tunneling: single electron phenomena and single electron transistor - Quantum dot laser - Ballistic transport - Carbon nanotubes: properties and applications - Material Processing by chemical vapor deposition and Laser ablation method - Graphene: properties and applications.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jasprit Singh, ―Semiconductor Devices: Basic Principles, Wiley 2012.
2. Donald Neaman, Dhrubes Biswas , Semiconductor Physics and Devices (SIE), 4th Edition, 2017
3. Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.
4. Kasap, S.O. ―Principles of Electronic Materials and Devices, McGraw-Hill Education, 2007.
5. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005.

REFERENCE BOOKS

1. Garcia, N. & Damask, A. ―Physics for Computer Science Students. Springer-Verlag, 2012.
2. Hanson, G.W. ―Fundamentals of Nanoelectronics. Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. ―Nanotechnology: Understanding small systems, CRC press, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on classical and quantum electron theories, and energy band structures.
CO2	Acquire knowledge on basics of semiconductor physics and its applications in various Devices.
CO3	Get knowledge on magnetic properties of materials and their applications in data storage.
CO4	Have the necessary understanding on the functioning of optical materials for Optoelectronics.
CO5	Understand the basics of quantum structures and their applications in carbon electronics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	2	2	3
CO3	3	3	1	1	2	2	1	1	1	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	3
CO5	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	Common for all Branches of B.E. / B. Tech Programmes	3	0	0	3

OBJECTIVES

- To study the inter relationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9
Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – Value of biodiversity – Consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega diversity nation – Hot spots of biodiversity – Threats to biodiversity– Habitat loss, poaching of wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act – Endangered and endemic species – Conservation of biodiversity – In-situ and ex-situ conservation of biodiversity.		**CO1**

UNIT II	ENVIRONMENTAL POLLUTION	9
Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste management: causes, effects and control measures of municipal solid wastes – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		**CO2**

UNIT III	NATURAL RESOURCES	9
Forest resources: Uses and over-exploitation – Deforestation – Case studies – Timber extraction, mining, dams and their effects on forests and tribal people – Water resources – Use and overutilization of surface and ground water, floods, drought, conflicts over water – Dams: benefits and problems – Mineral resources: Uses and exploitation – Environmental effects of extracting and using mineral resources – Case studies – Food resources: World food problems – Changes caused by agriculture and overgrazing – Effects of modern agriculture: fertilizer–pesticide problems, water logging, salinity – Case studies – Energy resources: Growing energy needs – Renewable and non renewable energy sources – Use of alternate energy sources – Case studies – Land resources: Land as a resource – Land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles – Field study of local area to document environmental assets – River / Forest / Grassland / Hill / Mountain.		**CO3**

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9
From unsustainable to sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Role of non-governmental organization – Environmental ethics – Issues and possible solutions – Climate change – Global warming – Acid rain, Ozone layer depletion –Nuclear accidents and holocaust – Case studies – Wasteland reclamation – Consumerism and waste products – Principles of Green Chemistry – Environment protection act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife protection Act – Forest conservation Act – Enforcement machinery involved in environmental legislation– Central and state pollution control boards– National Green Tribunal – Public awareness.		**CO4**
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth – Variation among nations – Population explosion – Family welfare programme – Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3. Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, (2007).
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press (I) Pvt, Ltd, Hydrabad, (2015).
3. G. Tyler Miller,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt.Ltd,Delhi, (2014).
4. R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5. Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6. Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To obtain knowledge about environment, ecosystems and biodiversity.
CO2	To take measures to control environmental pollution.
CO3	To gain knowledge about natural resources and energy sources.
CO4	To find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	To understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	3	3	3	3	2	2	2	3	2	1	2
CO2	3	2	3	3	2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	2	2	3	3	2	2	1	2	1	3	2	2	2
CO4	3	3	3	3	1	2	3	3	2	2	2	2	2	1	2
CO5	3	2	3	2	3	3	3	2	2	2	2	3	3	2	3

BE1251	BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To learn the fundamental laws, network theorems and analyse the electric circuits.
- To study the basic principles of electrical machines and their performance.
- To study the fundamentals of power systems.
- To learn the characteristics of various electron devices and Op Amp integrated circuit.
- To understand the principle and operation of measuring instruments and transducers.

UNIT I	ELECTRIC CIRCUITS ANALYSIS	9
Ohms Law, Kirchhoff's Law-Instantaneous power - Series and parallel circuit: analysis of resistive, capacitive and inductive network, star delta conversion, Nodal analysis and mesh analysis. Network theorems: Thevenin's theorem, Norton's theorem, superposition theorem and maximum power transfer theorem. Three phase ac supply –Instantaneous power, Reactive power and apparent power.		CO1
UNIT II	**ELECTRICAL MACHINES**	**9**
DC and AC ROTATING MACHINES: Types, Construction, principle, EMF and torque equation, application, Speed Control. Basics of Stepper Motor and Brushless DC motors. Transformers-Introduction, types and construction, working principle of Ideal transformer, EMF equation, All day efficiency calculation.		CO2
UNIT III	**FUNDAMENTALS OF POWER SYSTEM**	**9**
Structure of power system. Sources of electrical energy – Non-renewable, Renewable-Storage systems: Batteries-Ni-Cd, Pb -Acid and Li-ion, SOC (State of Charge), DOD (Depth of Discharge)Characteristics. Utilization of electrical power - DC and AC load applications. - Electric circuit Protection-need for earthing, fuses and circuit breakers.		CO3
UNIT IV	**ELECTRON DEVICES AND INTEGRATED CIRCUITS**	**9**
PN Junction-VI Characteristics of Diode, Zener diode, Rectifiers, Zener voltage regulator. Transistor configurations – CE amplifier - RC and LC oscillators. Op Amps – Basic characteristics and its applications.		CO4
UNIT V	**MEASURING INSTRUMENTS AND TRANSDUCERS**	**9**
Characteristic of measurement-errors in measurement – Principle and working of indicting instrument- Moving Coil meter, Moving Iron meter, Energy meter and watt meter, Cathode Ray Oscilloscope –- Transducers, thermo-electric, RTD, Strain gauge, LVDT, LDR, and piezoelectric transducer.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, fourth Edition, 2019
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

REFERENCE BOOKS

1. S.B. Lal Seksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. S.Chand & Co, 2008.
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, ―Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier, sixth edition,2017.
5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L.Wadhwa, ―Generation, Distribution and Utilisation of Electrical Energy‖, New Age international pvt.ltd.,2003

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to learn the fundamental laws, theorems of electrical circuits and to analyze them
CO2	Ability to understand the basic construction and operating principle of dc and ac machines.
CO3	Ability to understand the electrical power generation, energy storage and utilization of electric power.
CO4	Ability to understand the characteristics of various electronic devices and Op Amp integrated circuit.
CO5	Ability to understand the principles and operation of measuring instruments and transducers.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO2	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO3	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2
CO4	3	3	3	3	1	1	1	3	3	3	1	3	3	1	3
CO5	3	3	3	3	1	1	1	2	3	2	1	2	3	1	2

CS1206	PROGRAMMING IN C	L	T	P	C
	Common for CSE, IT, AI-DS, AI-ML	3	1	0	3

OBJECTIVES

- To develop C Programs using basic programming constructs
- To develop C programs using arrays, strings and functions
- To develop applications in C using pointers
- To develop applications in C using structures and union
- To develop applications using sequential and random-access file processing.

UNIT I	BASICS OF C PROGRAMMING	9
An overview of C: History of C; Compiler Vs. Interpreter, Structure of a C Program, Compiling a C Program; Basic data types: Modifiers, Variables: Type qualifiers, Storage class specifiers; Constants: Enumeration Constants; Keywords; Operators: Precedence and Associativity; Expressions: Order of evaluation, Type conversion in expression, Casts; Input/Output statements; Assignment statements, Selection statements; Iteration statements; Jump statements; Expression statements; Pre-processor directives: Compilation process.		**CO1**

UNIT II	ARRAYS, STRINGS AND FUNCTIONS	9
Introduction to Arrays: Declaration, Initialization, Single dimensional array, Two dimensional array, Array manipulations; String operations: length, compare, concatenate, copy; Functions: General form of a function, Function Arguments, Built-in functions, return statement, Recursion		**CO2**

UNIT III	POINTERS	9
Pointers: Declaring and defining pointers, Pointer operators, Pointer expression; Pointer assignment, Pointer conversions, Pointer arithmetic, Pointer comparisons; Pointers and Arrays: Array of pointers; Multiple indirection; Pointers to function; Problems with pointers; Parameter passing: Pass by value, Pass by reference.		**CO3**

UNIT IV	STRUCTURES AND UNIONS	9
Structure: Accessing structure members, structure assignments; Nested structures; Pointer and Structures; Array of structures; Passing structures to functions: Passing structure member to function, Passing entire structure to functions; Arrays in structures; Self-referential structures; Dynamic memory allocation; typedef statement, Union and Enumeration.		**CO4**

UNIT V	FILE PROCESSING	9
File system basics: File pointer, opening and closing a File; reading and writing character; working with String: fputs() and fgets(); rewind(); ferror(); fread() and fwrite(); Erasing files; Types of file processing: Sequential access; Random access: fprintf() and fscanf(), fseek() and ftell(); Command line arguments.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Herbert Schildt, C The Complete Reference, Fourth Edition, McGraw-Hill.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Kernighan, B.W and Ritchie,D.M, -The C Programming language‖, Second Edition, Pearson Education, 2006.

REFERENCE BOOKS

1. Paul Deitel and Harvey Deitel, -C How to Program, Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, -Programming in C, CENGAGE Learning India pvt. Ltd., 2011.
3. Pradip Dey, Manas Ghosh, -Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, -Computer Fundamentals and Programming in C, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C",McGraw-Hill Education, 1996.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications in C using basic constructs.
CO2	Design and implement applications using arrays, strings and functions.
CO3	Develop and implement applications in C using pointers.
CO4	Develop applications in C using structures and union.
CO5	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO4	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO5	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

GE 1207	ENGINEERING PRACTICES LABORATORY	L	P	T	C
	(Common to all branches of B.E. / B. Tech Programmes)	0	0	4	2

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **13**

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

a) Study of the joints in roofs, doors, windows and furniture.

b) Hands-on-exercise: Wood work, joints by sawing, planing and cutting.

CO1

II MECHANICAL ENGINEERING PRACTICE **18**

Welding:

a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending.

b) Model making – Trays and funnels.

c) Different type of joints.

Machine assembly practice:

a) Study of centrifugal pump

b) Study of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

CO2

GROUP B (ELECTRICAL & ELECTRONICS)		
III	**ELECTRICAL ENGINEERING PRACTICE** **13** 1. Residential house wiring using switches, fuse, indicator, lamp and energy meter. 2. Fluorescent lamp wiring. 3. Stair case wiring 4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	**CO3**
	5. Measurement of energy using single phase energy meter. 6. Measurement of resistance to earth of an electrical equipment.	**CO4**
IV	**ELECTRONICS ENGINEERING PRACTICE** **16** 1. Study of electronic components and equipment's – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR. 2. Study of logic gates AND, OR, EX-OR and NOT. 3. Generation of Clock Signal. 4. Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.	**CO5**
		TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	CIVIL	
1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 sets
2.	Carpentry vice (fitted to work bench)	15 Nos
3.	Standard woodworking tools 15 Sets.	15 Sets.
4.	Models of industrial trusses, door joints, furniture joints	5 each
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	2 Nos
	MECHANICAL	
1.	Arc welding transformer with cables and holders.	5 Nos
2.	Welding booth with exhaust facility.	5 Nos
3.	Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos
5.	Centre lathe.	2 Nos
6.	Hearth furnace, anvil and smithy tools.	2 Sets
7.	Moulding table, foundry tools.	2 Sets
8.	Power Tool: Angle Grinder.	2 Nos
9.	**Study-purpose items:** centrifugal pump, air-conditioner.	1 each

ELECTRICAL		
1.	Assorted electrical components for house wiring.	15 Sets
2.	Electrical measuring instruments.	10 Sets
3.	**Study purpose items:** Iron box, fan and regulator, emergency lamp.	1 each
4.	Megger (250V/500V).	1 No.
5.	**Power Tools:** (a) Range Finder (b) Digital Live-wire detector	2 Nos
ELECTRONICS		
1.	Soldering guns 10 Nos.	10 Nos.
2.	Assorted electronic components for making circuits 50 Nos.	50 Nos.
3.	Small PCBs.	10 Nos.
4.	Multimeters	10 Nos.
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	1 each

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO2	3	2	3	-	-	3	-	-	-	-	-	3	3	3	3
CO3	3	1	2	-	-	2	-	-	-	-	-	3	3	3	3
CO4	3	1	3	-	-	3	-	-	-	-	-	3	3	3	3
CO5	3	2	2	-	-	2	-	-	-	-	-	3	2	2	2

CS1208	PROGRAMMING IN C LABORATORY	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS

1. C programming using simple statements and expressions.	**CO1**
2. Scientific problem-solving using decision making and looping.	
3. Generating different patterns using multiple control statements.	
4. Problems solving using one dimensional array.	
5. Mathematical problem solving using two dimensional arrays.	
6. Solving problems using string functions.	**CO2**
7. Solving problems with user defined functions.	
8. Solving problems using recursive function.	
9. Solving problems with dynamic memory allocation.	
10. Realtime application using structures and unions.	
11. Realtime problem solving using sequential and random-access file.	**CO3**
12. Solving problems with command line argument.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Problem Solving and Program Design in C, 4th edition, by jeri R. Hanly and Elli B.Koffman.
2. Reema Thareja, “Programming in C”, Oxford University Press, Second Edition, 2016.
3. Programming in C by Pradip Dey, Manas Ghosh 2nd edition Oxford University Press.
4. E.Balaguruswamy, Programming in ANSI C 5th Edition McGraw-Hill.
5. A first book of ANSI C by Gray J.Brosin 3rd edition Cengagedelmer Learning India P.Ltd.
6. AL Kelly, Iraphol,Programming in C,4th edition Addison-Wesley – Professional.
7. Brain W.Kernighan & Dennis Ritchie, C Programming Language, 2nd edition, PHI.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop C programs for simple applications making use of basic constructs.
CO2	Develop C programs involving string, functions, recursion, pointers, and structures.
CO3	Design applications using sequential and random-access file processing.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO2	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2
CO3	3	3	3	2	2	1	1	1	1	1	1	1	2	2	2

MA1351	PROBABILITY AND STATISTICS	L	T	P	C
	Common for CSE, IT & AI-DS	4	0	0	4

OBJECTIVES

- To understand the basic concepts of probability, one- and two-dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in engineering applications.
- To acquaint the knowledge of testing of hypothesis for small and large samples, which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I	PROBABILITY AND RANDOM VARIABLES	12
Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.		CO1
UNIT II	**TWO - DIMENSIONAL RANDOM VARIABLES**	**12**
Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Central limit theorem (for independent and identically distributed random variables).		CO2
UNIT III	**RANDOM PROCESSES**	**12**
Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.		CO3
UNIT IV	**TESTING OF HYPOTHESIS**	**12**
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) – Goodness of fit.		CO4
UNIT V	**DESIGN OF EXPERIMENTS**	**12**
One way and Two way classifications - Completely randomized design – Randomized block design –Latin square design - 2^2 factorial design.		CO5
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2017.
2. Ibe, O.C., —Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Indian Reprint, 2014.

REFERENCE BOOKS

1. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2017.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2017.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 4th Edition,Elsevier, 2009.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Get exposure to random variables and well-founded knowledge of standard distributions which can describe real life phenomena.
CO2	Get ideas to handle situations involving more than one random variable.
CO3	Gain an understanding and characterizes phenomena which evolve with respect to time in a probabilistic manner and modelling the real-life phenomena.
CO4	Gain the knowledge on Large Samples and Small Samples. These concepts are very useful in biological, economical and social experiments and all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO5	Do design of experiments, carry them out, and analyze the data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	2	1	-	-	-	-	1	1	3	2	1
CO2	3	3	2	2	2	1	-	-	-	-	1	1	3	2	1
CO3	3	2	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	3	2	3	3	2	1	-	-	-	2	2	3	2	1
CO5	3	3	2	3	2	2	1	-	-	-	1	2	2	1	1

DS1301	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make students understand the basic structure and operation of digital computer
- To familiarize with implementation of fixed point and floating-point arithmetic operations
- To study the design of data path unit and control unit for processor
- To understand the concept of various memories and interfacing
- To introduce the parallel processing technique

UNIT I	COMPUTER ORGANIZATION & INSTRUCTIONS	9
Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations		CO1
UNIT II	**ARITHMETIC UNIT**	9
Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism		CO2
UNIT III	**PROCESSOR AND CONTROL UNIT**	9
Introduction, Logic Design Conventions, Building a Datapath - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions		CO3
UNIT IV	**MEMORY AND I/O ORGANIZATION**	9
Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices		CO4
UNIT V	**ADVANCED COMPUTER ARCHITECTURE**	9
Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. David A. Patterson and John L. Hennessey, —Computer Organization and Design, Fifth edition, Morgan Kauffman / Elsevier, 2014. (UNIT I-V)
2. Miles J. Murdocca and Vincent P. Heuring, —Computer Architecture and Organization: An Integrated approach, Second edition, Wiley India Pvt Ltd, 2015 (UNIT IV,V)

REFERENCE BOOKS

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, —Computer Organization—, Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings —Computer Organization and Architecturell, Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, —Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe data representation, instruction formats and the operation of a digital computer
CO2	Illustrate the fixed point and floating-point arithmetic for ALU operation
CO3	Discuss about implementation schemes of control unit and pipeline performance
CO4	Explain the concept of various memories, interfacing and organization of multiple processors
CO5	Discuss parallel processing technique and unconventional architectures

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2	1	2	-	-	1	-	-	1	2	3	3	2
CO2	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2
CO3	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2
CO4	2	3	2	1	2	-	-	1	-	-	1	2	3	3	2
CO5	2	3	2	1	2	-	-	1	-	-	1	2	3	2	2

CS1302	DATA STRUCTURES	L	T	P	C
	Common to CSE, IT, AI-DS, AI-ML & ECE Semester IV	3	1	0	3

OBJECTIVES

- To understand the concepts of ADTs.
- To learn linear data structures like lists, stacks, and queues.
- To learn Non-linear tree data structures.
- To apply Graph structures
- To understand sorting, searching and hashing algorithms

UNIT I	LINEAR DATA STRUCTURES – LIST	9
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —- singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).		CO1
UNIT II	**LINEAR DATA STRUCTURES – STACKS, QUEUES**	**9**
Stack ADT – Operations – Applications – Evaluating arithmetic expressions- Conversion of Infix to postfix expression – Queue ADT – Operations – Circular Queue – Priority Queue – deQueue – applications of queues.		CO2
UNIT III	**NON-LINEAR DATA STRUCTURES – TREES**	**9**
Tree ADT – tree traversals – Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree – B+ Tree – Heap – Applications of heap.		CO3
UNIT IV	**NON-LINEAR DATA STRUCTURES – GRAPHS**	**9**
Definition – Representation of Graph – Types of graph – Breadth-first traversal – Depth-first traversal – Topological Sort – Bi-connectivity –Graph Algorithms – Shortest Path Algorithms: Dijkstra's Algorithm – All pair shortest Path Algorithms: Floyds warshall Algorithm – Minimum Spanning Tree: Prim's Algorithm – Kruskal's Algorithm – Applications of Graph.		CO4
UNIT V	**SEARCHING, SORTING AND HASHING TECHNIQUES**	**9**
Searching- Linear Search – Binary Search. Sorting – Bubble sort – Selection sort – Insertion sort – Shell sort – Radix sort - Merge sort – Quick sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C‖, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, —Data Structures Using C‖, Second Edition , Oxford University Press, 2011.
3. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley,2013.
4. Bradley N. Miller, David L. Ranum, " Problem Solving with Algorithms and Data Structures using Python " , Second Edition, 2013.
5. Rance D. Necaise, Data Structures and Algorithms Using Python, John Wiley & Sons, 2011.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement abstract data types for linear data structures.
CO2	Apply the different linear data structures to problem solutions.
CO3	Implement abstract data types for non-linear data structures.
CO4	Apply Graph data structure for the real world problems.
CO5	Critically analyze the various sorting, searching algorithms and hash functions that result in a collision free scenario for data storage and retrieval.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	3

DS1302	OBJECT ORIENTED PROGRAMMING (Lab Integrated)	L	T	P	C
		3	0	2	4

OBJECTIVES

- ❖ Analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- ❖ Design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- ❖ To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I	JAVA FUNDAMENTALS	9 +6
Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and StringBuffer **Lab Component:** 1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 - 4ac$ is negative, display a message stating that there are no real solutions. 2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the n^{th} value in the Fibonacci sequence		**CO1**
UNIT II	**OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE**	**9 + 6**
Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes. **Lab Component:** 1. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number of Sides ( ) that shows the number of sides in the given geometrical figures 2. Write a Java program that counts the number of objects created by using static variable		**CO2**
UNIT III	**EXCEPTIONS, COLLECTIONS AND STREAMS**	**9 + 6**
Exceptions – exception hierarchy – throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files. **Lab Component:** 1. Write a Java program to make frequency count of words in a given text 2. Write a Java program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).		**CO3**

UNIT IV	CONCURRENT PROGRAMMING AND GUI PROGRAMMING	9 + 6
Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag. 1. Write a Java program that creates three threads. First thread displays “Good Morning” everyone second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds. 2. Write a java Program to create a window when we press i. M or m the window displays Good Morning ii. A or a the window displays Good After Noon iii. E or e the window displays Good Evening iv. N or n the window displays Good Night		**CO4**
UNIT V	**JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING**	**9 + 6**
Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress, TCP/IP Client and Server Sockets – Cookies and Datagrams. 1. Develop a program for executing the remote command using TCP Socket 2. Create a GUI program in java with the following components. i. A frame with Flow layout. ii. Add the following components on to the frame. a) Two Text Field b) A button with the label display iii. Allow the user to enter data into the JTextField iv. When the button is clicked paint the frame by displaying the data entered in the JTextField v. Allow the user to properly close the frame		**CO5**
PRACTICALS : 45 PERIODS	**THEORY : 30 PERIODS**	**TOTAL:75 PERIODS**

TEXT BOOKS

1. Herbert schildt , “The complete reference”, 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2. Cay S. Horstmann, “Core Java SE 9 for the Impatient”, 2nd Edition, Addison-Wesley,2017 .
3. Paul Deitel, Harvey M. Deitel, “Java How to Program”, 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1. T. Budd, “An Introduction to Object Oriented Programming”, 3rd Edition, Pearson Education, 2009.
2. Y. Daniel Liang , “Introduction to Java programming”, 7th Edition, Pearson education, 2010.
3. C Xavier , “Java Programming – A Practical Approach”, Tata McGraw-Hill Edition, 2011.
4. K. Arnold and J. Gosling, “The Java programming language”, 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamental ideas behind the object-oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification
CO3	A modern coverage of concurrent programming that focuses on high-level synchronization constructs
CO4	Know the concept of event handling used in GUI.
CO5	Develop Server Programming Applications

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	2	-	-	2	1	1	1	2	2	1
CO2	1	1	2	1	1	1	2	1	2	1	1	1	2	2	2
CO3	1	1	1	1	1	-	-	1	2	2	2	1	1	2	2
CO4	1	1	2	-	1	-	1	-	1	1	2	1	3	1	3
CO5	2	2	2	2	2	-	1	1	2	1	2	2	1	2	2

DS1303	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	C
	Common for AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To impart basic knowledge about Artificial Intelligence
- To learn the methods of solving problems using Artificial Intelligence
- To learn to represent knowledge in solving AI problems
- To understand the concept of Planning in various situations
- To understand the application of AI namely Expert Systems

UNIT I	INTRODUCTION	9
Introduction–Definition – Foundation and History of AI - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Agents and Environments – Nature of Environments – Structure of Agents - Typical Intelligent Agents		CO1
UNIT II	**PROBLEM SOLVING METHODS**	**9**
Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning		CO2
UNIT III	**KNOWLEDGE REPRESENTATION**	**9**
First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for categories – Reasoning with Default Information		CO3
UNIT IV	**PLANNING**	**9**
Planning – Introduction – Planning Problem – Planning with State Space Search - Partial Order planning – Construction and Use of Planning Graphs - Conditional Planning – Continuous Planning – Multi Agent Planning		CO4
UNIT V	**EXPERT SYSTEMS**	**9**
Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Russell S and Norvig P, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

REFERENCE BOOKS

1. M. Tim Jones - Artificial Intelligence: A Systems Approach (Computer Science), Jones and Bartlett Publishers, Inc.; First Edition, 2008.
2. I. Bratko - Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.
4. Dan W. Patterson - Introduction to Artificial Intelligence and Expert Systems, PHI, New Delhi, 2006.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement basic AI Algorithms
CO2	Use appropriate search algorithms to solve AI based problems
CO3	Represent a problem using first order and predicate logic
CO4	Design a simple agent system with associated planning technique.
CO5	Apply AI techniques to real-world problems to develop expert system

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES(PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	2	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3

DS1304	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the foundation of Data Science using Python.
- To perform statistical data analysis and prediction.
- To be familiar with supervised and unsupervised methods in machine learning.
- To understand the algorithm for massive data problems and clustering.
- To learn about different topic and graphical models

UNIT I	DATA SCIENCE AND PYTHON	9
Introduction to Data Science: Computational Tools - Need for data science - Causality and Experiments; Array Computing in Python: Vectors - Arrays - Advanced Vectorization of Functions - Higher- Dimensional Arrays: Matrices and Arrays; Dictionaries and Strings, Fundamental Python Libraries		CO1
UNIT II	**STATISTICAL DATA ANALYSIS**	**9**
Data Preparation - Exploratory Data Analysis – Estimation - Statistical Inference – Measuring Variability- EDA Case Study- Hypothesis Testing- Prediction - Inference for Regression.		CO2
UNIT III	**MACHINE LEARNING**	**9**
The Perceptron Algorithm - Kernel Functions - Overfitting and Uniform Convergence - Regularization - Support Vector Regularization - Support Vector Machines - Strong and Weak Learning – Stochastic Gradient Descent.		CO3
UNIT IV	**DATA STREAMS AND CLUSTERING**	**9**
Algorithms for Massive Data Problems: Frequency Moments of Data Streams – Matrix Algorithms using Sampling, Sketches of Documents; Clustering: k-Means Clustering, k-Center Clustering - Spectral Clustering – Community Finding and Graph Partitioning.		CO4
UNIT V	**TOPIC MODELS AND GRAPHICAL MODELS**	**9**
Topic Models – Non-negative Matrix Factorization - Latent Dirichlet Allocation - Hidden Markov Models - Bayesian Belief Networks - Markov Random Fields		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Avrim Blum,John Hopcroft, Ravindran Kannan, “Foundations of Data Science”, 1st Edition, Cambridge University Press , 2020. (Unit III,IV & V)
2. Ani Adhikari, JohnDeNero, “Computational and Inferential Thinking: The Foundations of Data Science”, GitBook, 2017. (Unit I,II)
3. Laura Igual, Santi Segui,”Introduction to Data Science: A Python Approach to Concepts, Techniques and Application”, Springer, 2017. (Unit II)

REFERENCE BOOKS

1. Dr .Gypsy Nandi & Dr.Rupam Kumar Sharma, “Data Science Fundamentals and Practical Approaches: Understand Why Data Science is the Next”, BPB Publisher, 2020
2. Hans Petter Langtangen, “A Primer on Scientific Programming with Python”, 4th Edition, Springer, 2016.
3. Jonathan Dinu,“Foundations of Data Science : A Practical Introduction to Data Science with Python”, Addison-Wesley Data& Analytics Series,2016.
4. EMC Education Services, “Data Science and Big Data Analytics : Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
5. Joel Grus,”Data Science from Scratch: First Principles with Python”, O’Reilly, 2015
6. JureLeskovek, Anand Rajaraman, Jeffrey Ullman, “Mining of Massive Datasets”, V2.1, Cambridge University Press, 2014.
7. Cathy O’Neil, Rachel Schutt.“Doing Data Science, Straight Talk from The Frontline”, O’Reilly, 2014.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze the data using Python programs
CO2	Demonstrate knowledge of statistical data analysis techniques.
CO3	Demonstrate machine learning algorithms in practice by developing the applications.
CO4	Understand the principles of handling data streams and clustering.
CO5	Understand different topic and graphical modeling techniques in real world problem.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	2	2	2	-	3	3	2	2
CO2	3	3	3	3	2	-	-	2	2	2	-	3	3	3	2
CO3	3	3	3	3	2	-	-	2	2	2	-	3	3	3	2
CO4	3	3	3	3	2	-	-	2	2	2	-	3	3	3	2
CO5	3	3	3	3	2	-	-	2	2	2	-	3	3	3	2

DS1307	DATA STRUCTURE LABORATORY USING PYTHON	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To introduce the concepts of primitive data structures.
- To understand the process in linear and non-linear data structures.
- To introduce the concepts of sorting, searching and hashing.

LIST OF EXPERIMENTS

1. IMPLIMENTATION OF LIST Write Python programs to a. Array implementation of Stack ADTs. b. Array implementation of Queue ADTs.	**CO1**
2. LIST ADT Array implementation of List ADT.	
3. IMPLEMENTATION OF STACK AND QUEUE Write Python programs to a. Design and implement Single Linked List. b. Design and implement Stack and its operations using List. c. Design and implement Queue and its operations using List.	
4. APPLICATIONS OF LINEAR DATA STRUCTURE Write Python programs for the following: a. Design and implement polynomial ADT using list b. Uses Stack operations to convert infix expression into postfix expression. c. Uses Stack operations for evaluating the postfix expression.	**CO2**
5. APPLICATIONS OF TREE a. Write a Python program to Design and implement binary tree. b. Traverse the above binary tree recursively in pre-order, post-order & in-order.	
6. IMPLEMENTATION OF TREE Write a Python program to Design and implement binary search tree.	
7. IMPLEMENTATION OF ADVANCED TREE a. Design and Implement AVL tree using Templates. b. Design and Implement heap tree using Templates.	**CO3**
8. IMPLEMENTATION OF SHORTEST PATH ALGORITHMS Write Python programs for the following: a. Design and Implement Dijkstra's algorithm b. Design and Implement Floyd Warshall algorithm.	**CO3**
9. IMPLEMENTATION OF MINIMUM SPANNING TREE Write Python programs for the following: a. Design and Implement Kruskal's algorithm. b. Design and Implement Prim's algorithm.	
10. GRAPH TRAVERSAL & APPLICATIONS Write Python programs to implement the following algorithms: a. Depth first search. b. Breadth first search. c. Toplogical Sorting.	

11. SORTING &SEARCHING AND HASH TABLE IMPLEMENTATION

a. Write Python programs for implementing the following sorting techniques to arrange a list of integers in ascending order.
   i. Insertion sort
   ii. Selection sort
   iii. Quick sort
   iv. Merge sort

b. Write Python programs for implement linear search and binary search.

c. Write Python programs for implement Hashing – any two collision techniques

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Rance D. Necaise, Data Structures and Algorithms Using Python, Willy Student Edition, 2016.

WEB REFERENCES

1. https://cloudacademy.com/lab/python-lab-1/
2. https://www.python.org/downloads/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Write functions to implement linear and non-linear data structure operations
CO2	Suggest appropriate linear / non-linear data structure operations for solving a given problem
CO3	Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

MAPPING OF COs WITH POs AND PSOs

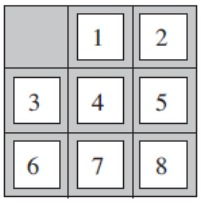
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	3	3	3	3	2

DS1308	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To get familiarized with the structure of agents
- To solve simple toy world problems
- To understand and develop solutions through search strategies.
- To develop solutions for constraint satisfaction problems.
- To increase the knowledge about real-world problems and how to plan and act in the real world and to get familiarized with expert systems

LIST OF EXPERIMENTS

1. Developed a simple reflex agent program in Python for the vacuum-cleaner world problem. This particular world has just two locations: squares A and B. The vacuum agent perceives which square it is in and whether there is dirt in the square. It can choose to move left, move right, suck up the dirt, or do nothing.	**CO1**
2. Solve the 8-puzzle problem, which consists of a 3×3 board with eight numbered tiles and a blank space. A tile adjacent to the blank space can slide into the space. The objective is to reach a specified goal state as given below. Find minimum number of steps required to reach the goal.  Goal State	
3. Write a Python program to solve N Queen Problem using backtracking. The N Queen is the problem of placing N chess queens on an N×N chessboard so that no two queens attack each other.	
4. Write a Python program for a path search problem to find a path from point A to point B using A* Search Algorithm.	**CO2**
5. Using Hill Climbing Search Algorithm, find the solution for a Travelling Salesman Problem, which has to find the shortest route from a starting location and back to the starting location after visiting all the other cities.	
6. Given an undirected graph and a number m, determine if the graph can be coloured with at most m colours such that no two adjacent vertices of the graph are colored with the same color. Here coloring of a graph means the assignment of colors to all vertices.	
7. Solve the cryptarithmetic puzzle SEND+MORE=MONEY using a Python program. Find digits that replace letters to make a mathematical statement true. Each letter in the problem represents one digit (0–9). No two letters can represent the same digit. When a letter repeats, it means a digit repeats in the solution.	
8. Write a Python program to solve Sudoko. Given an initial 9x9 grid of cells containig numbers between 1 and 9 or blanks, all blanks must be filled with numbers. You win Sudoko if you find all values such that every row, column, and 3x3 subsquare contains the numbers 1–9, each with a single occurrence.	

9. A job shop consists of a set of distinct machines that process jobs. Each job is a series of tasks that require use of particular machines for known durations, and which must be completed in specified order. Implement the job shop scheduling problem to schedule the jobs on the machines to minimize the time necessary to process all jobs.	**CO3**
10. Demonstrate the use of MYCIN: a medical expert system. Implement a small example of an expert system; which defines a few contexts, parameters, and rules, and presents a rudimentary user interface to collect data about an infection in order to determine the identity of the infecting organism.	
TOTAL : 60 PERIODS	

REFERENCE BOOKS

1. Russell S and Norvig P, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

WEB REFERENCES

1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm
2. https://www.edureka.co/blog/artificial-intelligence-with-python/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Familiarized with the structure of agents, implement simple agents and develop solutions for simple toy world problems.
CO2	Implement and develop solutions for problems through different search strategies. Identify constraints of problems and develop solutions for constraint satisfaction problems.
CO3	Approach a real-world problem, develop a plan and then solve those problems and use expert systems.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	1	1	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	2	1	1	1	2	2	2	3	3	3	3

MA1453	DISCRETE MATHEMATICS	L	T	P	C
	Common for CSE, IT & AI-DS	4	0	0	4

OBJECTIVES

- To introduce Mathematical Logic, Inference Theory and proof methods.
- To provide fundamental principles on combinatorial counting techniques.
- To introduce graph models, their representation, connectivity and traverse ability.
- To explain the fundamental algebraic structures, groups and their algebraic properties.
- To introduce partial ordering and some functions on a set.

UNIT I	LOGIC AND PROOFS	12
Propositional Logic – Propositional Equivalences – Normal Forms - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.		CO1
UNIT II	**COMBINATORICS**	**12**
Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations -Generating Functions - Solving Linear Recurrence Relations Using Generating Functions– Inclusion – Exclusion – Principle and Its Applications.		CO2
UNIT III	**SETS AND FUNCTIONS**	**12**
Set -Relations on sets – Types of relations and their properties – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram. Functions: Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.		CO3
UNIT IV	**GRAPHS**	**12**
Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.		CO4
UNIT V	**ALGEBRAIC STRUCTURES**	**12**
Groups – Subgroups – Homomorphisms – Isomorphism - Normal Subgroup and Coset – Lagrange's Theorem.		CO5

TOTAL : 60 PERIODS

TEXT BOOKS

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2012.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, Thirtieth Reprint, New Delhi, 2011.

REFERENCE BOOKS

1. Ralph. P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, Fifth Edition, New Delhi, 2014
2. Seymour Lipschutz and Mark Lipson," Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., Third Edition, New Delhi, 2013.
3. Thomas Koshy," Discrete Mathematics with Applications", Elsevier Publications, Boston, 2004.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Construct proofs by using direct proof, proof by contraposition, proof by contradiction. Construct mathematical arguments using logical connectives and quantifiers and verify the correctness of an argument using propositions. Logic helps in arriving inferences for any problem.
CO2	Solve problems on permutation and combination. Prove mathematical theorems using mathematical induction. Demonstrate basic counting principles, compute and interpret the meaning in the context of the particular application which helps to apply the combinatorial techniques in Algorithms and Data structure for analysis and design.
CO3	Understand relations on a set and functions on a set
CO4	Apply the concepts of graph theory in data structures, data mining, image segmentation and in clustering.
CO5	Familiar with algebraic systems, groups, sub groups, Lagrange's theorem and normal subgroups. In Coding algorithms and in theoretical computer science algebraic structures are applied.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO2	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO3	3	3	2	2	1	1	-	-	-	1	1	2	2	2	1
CO4	3	3	2	2	1	1	-	-	-	-	1	2	2	2	1
CO5	3	3	2	2	1	1	-	-	-	-	1	2	2	1	1

CS1401	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To learn the general framework for analyzing algorithm efficiency
- To be conversant with algorithms for common problems.
- To analyse the algorithms for time/space complexity.
- To write algorithms for a given problem using different design paradigms.
- To understand computational complexity of problems

UNIT I	INTRODUCTION	9
Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – The Analysis Framework – Asymptotic Notations and Basic Efficiency Classes – Mathematical Analysis of Nonrecursive and Recursive Algorithms – Empirical Analysis of Algorithms.		CO1
UNIT II	**DECREASE AND CONQUER AND DIVIDE-AND-CONQUER**	**9**
Decrease-and-Conquer– Insertion Sort – Binary Search – Computing a Median and the Selection Problem – Divide-and-Conquer – Merge Sort – Quicksort – The Closest –Pair and Convex –Hull Problems by Divide-and-Conquer.		CO2
UNIT III	**DYMANIC PROGRAMMING AND GREEDY TECHNIQUE**	**9**
The Knapsack Problem and Memory Functions – Optimal Binary Search Trees – Warshall's Algorithm – Floyd's Algorithm – Greedy Technique – Prim's Algorithm – Kruskal's Algorithm – Dijkstra's Algorithm – Huffman Trees and Codes.		CO3
UNIT IV	**ITERATIVE IMPROVEMENT**	**9**
Graphical Method – The Simplex Method – The maximum Flow Problem – Maximum Matching in Bipartite Graphs – The Stable Marriage Problem.		CO4
UNIT V	**BACKTRACKING, BRANCH-AND-BOUND AND APPROXIMATION ALGORITHMS**	**9**
P, NP, and NP- Complete Problems – Backtracking – n-Queens Problem – Hamiltonian Circuit Problem – Subset-Sum Problem – Branch-and-Bound – Assignment Problem – Knapsack Problem – Traveling Salesman Problem – Approximation Algorithms for the Traveling Salesman Problem and the Knapsack Problem.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2009.

REFERENCE BOOKS

1. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008.
2. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education, 2011.
3. Donald E. Knuth, "Art of Computer Programming, Volume I - Fundamental Algorithms", Third Edition, Addison Wesley, 1997.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Ability to investigate an algorithm's efficiency with respect to running time
CO2	Design and implement problems using algorithmic design techniques such as decrease and conquer and divide and conquer
CO3	Ability to understand the design techniques such as Dynamic programming and Greedy technique
CO4	Ability to understand the iterative design techniques
CO5	Understand the variations among tractable and intractable problems

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO2	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO3	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO4	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2
CO5	3	3	3	3	2	-	-	-	3	-	2	3	3	2	2

CS1402	OPERATING SYSTEMS	L	T	P	C
	Common for CSE, IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android

UNIT I	OPERATING SYSTEM OVERVIEW	9
Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.		CO1

UNIT II	PROCESS MANAGEMENT	9
Processes – Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization – The critical-section problem, Semaphores, Classical problems of synchronization, Monitors; Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.		CO2

UNIT III	STORAGE MANAGEMENT	9
Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Need for Page Replacement, Page Replacement Algorithm, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		CO3

UNIT IV	FILE SYSTEMS AND I/O SYSTEMS	9
Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.		CO4

UNIT V	CASE STUDY	9
Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, —Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS

1. RamazElmasri, A. Gil Carrick, David Levine, ―Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7 th Edition, Prentice Hall, 2011.
3. AchyutS.Godbole, AtulKahate, ―Operating Systems‖, McGraw Hill Education, 2016.
4. Andrew S. Tanenbaum, ―Modern Operating Systems‖, 4th Edition, Pearson Education, 2014.
5. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", Second Edition, Tata McGraw-Hill Education
6. Daniel P Bovet and Marco Cesati, ―Understanding the Linux kernel‖, 3rd edition, O'Reilly, 2005.
7. Neil Smyth, ―iPhone iOS 4 Development Essentials – Xcode‖, Fourth Edition, Payload media, 2011.
8. http://nptel.ac.in/.
9. William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9 th Edition (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Analyze various scheduling algorithms.
CO2	Understand deadlock, prevention and avoidance algorithms.
CO3	Compare and contrast various memory management schemes.
CO4	Understand the functionality of file systems.
CO5	Perform administrative tasks on Linux Servers and Compare iOS and Android

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

CS1403	DATABASE DESIGN AND MANAGEMENT (Lab Integrated)	L	T	P	C
	Common to CSE, IT, AI-DS & AI-ML	3	0	2	4

OBJECTIVES

- ❖ To learn the fundamentals of data models, ER diagrams and to study SQL and relational database design.
- ❖ To familiarize relational model with Relational Database design and Normal Forms.
- ❖ To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- ❖ To understand the implementation techniques by learning file organization and Query Optimization.
- ❖ To understand the concepts of distributed databases, Object Oriented databases and XML databases.

UNIT I	INTRODUCTION TO RELATIONAL DATABASES	9 + 6
Purpose of Database System – Views of data – Data Models – Database System Architecture Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping– Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features **Lab Component** • Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements .Database Querying – Simple queries, Nested queries, Sub queries and Joins • Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views, Synonyms, Sequences. • Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)		**CO1**
UNIT II	**RELATIONAL DATABASE DESIGN**	**9 + 6**
Embedded SQL– Dynamic SQL - Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form **Lab Component** • Simple Embedded SQL Program to demonstrate the concepts. • Database Design using normalization and Implementation for any application.		**CO2**
UNIT III	**TRANSACTIONS**	**9 + 6**
Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery – Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery. **Lab Component** • Usage of Transaction control language commands like commit, rollback and save point. • Develop Programs using BEFORE and AFTER Triggers for INSERT, DELETE and UPDATE statements		**CO3**
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9 + 6**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing. Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation. **Lab Component** • Implementation of B tree and B+ Tree. • Develop programs to demonstrate hashing techniques.		**CO4**

UNIT V	ADVANCED TOPICS	9 + 6
Distributed Databases: Architecture, Data Storage, Data Fragmentation - Replication and Allocation Techniques for Distributed Database Design. Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery. **Lab Component** • Database Connectivity with Front End Tools • Case Study using real life database applications.		**CO5**

PRACTICALS: 30 PERIODS	THEORY: 45 PERIODS	TOTAL : 75 PERIODS

TEXT BOOKS

1. Ramez Elmasri and Shamkant B. Navathe; Fundamentals of Database Systems, Pearson, Seventh Edition, Global Edition,2016
2. A Silberschatz, H Korth, S Sudarshan, “Database System and Concepts”, fifth Edition McGraw-Hill,2012.
3. Vlad Vlasceanu, Wendy A. Neu, Andy Oram, Sam Alapati, An Introduction to Cloud Databases, O'Reilly Media, Inc.,2019.

REFERENCE BOOKS

1. C.J.Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education,2004.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Map ER model to Relational model to perform database design effectively
CO2	Able to understand the various normal forms and to minimize the redundancy in the relations
CO3	Able to know the logic behind the transaction processing, concurrency control and to recover system from failures.
CO4	Able to organize, index the files and to optimize the given queries
CO5	Able to know the concepts of distributed databases, Object Oriented databases and XML databases

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO2	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO3	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO4	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3
CO5	3	3	3	3	2	1	1	-	-	2	2	2	2	3	3

ML1401	FOUNDATIONS OF MACHINE LEARNING	L	T	P	C
	Common for IT, AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To understand the basic concepts of machine learning and probability theory.
- To appreciate supervised learning and their applications.
- To understand unsupervised learning like clustering and EM algorithms.
- To understand the theoretical and practical aspects of probabilistic graphical models.
- To learn other learning aspects such as reinforcement learning, representation learning, deep learning, neural networks and other technologies.

UNIT I	INTRODUCTION	9
Machine Learning – Types of Machine Learning – Supervised Learning – Unsupervised Learning – Basic Concepts in Machine Learning – Machine Learning Process – Weight Space – Testing Machine Learning Algorithms – A Brief Review of Probability Theory –Turning Data into Probabilities – The Bias-Variance Trade-off, FIND–S Algorithm, Candidate Elimination Algorithm		CO1
UNIT II	**SUPERVISED LEARNING**	**9**
Linear Models for Regression – Linear Basis Function Models – The Bias-Variance Decomposition – Bayesian Linear Regression – Common Regression Algorithms – Simple Linear Regression – Multiple Linear Regression – Linear Models for Classification – Discriminant Functions – Probabilistic Generative Models – Probabilistic Discriminative Models – Laplace Approximation – Bayesian Logistic Regression – Common Classification Algorithms – k-Nearest Neighbors – Decision Trees – Random Forest model – Support Vector Machines		CO2
UNIT III	**UNSUPERVISED LEARNING**	**9**
Mixture Models and EM – K-Means Clustering – Dirichlet Process Mixture Models – Spectral Clustering – Hierarchical Clustering – The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA)		CO3
UNIT IV	**GRAPHICAL MODELS**	**9**
Bayesian Networks – Conditional Independence – Markov Random Fields – Learning – Naive Bayes Classifiers – Markov Model – Hidden Markov Model.		CO4
UNIT V	**ADVANCED LEARNING**	**9**
Reinforcement Learning – Representation Learning – Neural Networks – Active Learning – Ensemble Learning – Bootstrap Aggregation – Boosting – Gradient Boosting Machines – Deep Learning		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2015.

REFERENCE BOOKS

1. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, CRC Press, 2014.
4. Tom Mitchell, “Machine Learning”, McGraw-Hill, 2017.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
6. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Gain knowledge about basic concepts of machine learning techniques
CO2	Develop predictive model based on both input and output data
CO3	Ability to understand the unsupervised learning algorithm and dimensionality reduction techniques
CO4	Design systems that use the appropriate graphical models of machine learning
CO5	Ability to address the problem of learning control strategies for autonomous agents

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

DS1401	PYTHON PROGRAMMING FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize the data scientists, work environment like IPython and Jupyter.
- To understand ndarray object for efficient storage and manipulation of dense data arrays in python using NumPy.
- To understand DataFrame object for efficient storage and manipulation of labelled / columnar data in python using Pandas.
- To perform data visualizations in python using Matplotlib.
- To practice machine learning algorithms in python using Scikit-Learn.

UNIT I	IPYTHON: BEYOND NORMAL PYTHON	9
Shell and Notebook- Help and Documentation in IPython- Keyboard Shortcuts in the IPython Shell- IPython Magic Commands- Input and Output History- IPython and Shell Commands- Errors and Debugging- Profiling and Timing Code.		CO1
UNIT II	**INTRODUCTION TO NUMPY**	**9**
Understanding Data Types in Python- The Basics of NumPy Arrays- Computation on NumPy Arrays: Universal Functions- Aggregations- Computation on Arrays- Comparisons, Masks, and Boolean Logic- Fancy Indexing- Sorting Arrays- Structured Data.		CO2
UNIT III	**DATA MANIPULATION WITH PANDAS**	**9**
Installing and Using Pandas- Introducing Pandas Objects- Data Indexing and Selection- Operating on Data in Pandas- Handling Missing Data- Hierarchical Indexing- Combining Datasets- Aggregation and Grouping- Pivot Tables- Vectorized String Operations- Working with Time Series- High-Performance Pandas.		CO3
UNIT IV	**VISUALIZATION WITH MATPLOTLIB**	**9**
General Matplotlib Tips- Simple Line Plots- Simple Scatter Plots- Visualizing Errors- Density and Contour Plots- Histograms, Binnings, and Density- Customizing Plot Legends- Customizing Colorbars- Multiple Subplots- Text and Annotation- Customizing Ticks- Customizing Matplotlib- Three-Dimensional Plotting in Matplotlib- Geographic Data with Basemap- Visualization with Seaborn.		CO4
UNIT V	**MACHINE LEARNING WITH SCIKIT-LEARN**	**9**
Machine Learning- Introducing Scikit-Learn- Hyperparameters and Model Validation- Feature Engineering- Naive Bayes Classification- Linear Regression- Support Vector Machines- Decision Trees and Random Forests- Principal Component Analysis- k-Means Clustering- Gaussian Mixture Models- Application: A Face Detection Pipeline.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017

REFERENCE BOOKS

1. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
2. Python for data science for dummies 2nd Edition, John Paul Mueller, Luca Massaron, Wiley

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Use data scientists work environment like IPython and Jupyter.
CO2	Use ndarray object for efficient storage and manipulation of dense data arrays in python using NumPy.
CO3	Use DataFrame object for efficient storage and manipulation of labeled/columnar data in python using Pandas.
CO4	Perform data visualizations in python using Matplotlib.
CO5	Use machine learning algorithms in python using Scikit-Learn.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO2	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO3	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO4	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3
CO5	3	3	3	3	3	2	2	1	2	1	2	3	3	3	3

DS1407	DATA SCIENCE LABORATORY USING PYTHON	L	T	P	C
		0	0	4	2

OBJECTIVES

- To provide knowledge of Data Exploration using Programming APIs and Freely Available Tools.
- To understand the concept of Data Formation.
- To visualize the data using various Python API.
- To use latest python libraries for Data Science in Real Time Applications.

LIST OF EXPERIMENTS

1. Python Environment Setup using Anaconda.	**CO1**
2. Perform Mathematical Computing using NumPy - Array and Matrices.	
3. Data Manipulation using Pandas – Importing Data, Understanding Data Frame, Indexing Data Frames, View and Select Data Demo	**CO2**
4. Data Manipulation using Pandas – Data Operations, Missing Values, Renaming Columns, File Read and Write, Pandas SQL Operations.	
5. Scientific Computing using SciPy - Special Function Package, Linear Algebra - Feature Engineering	
6. Scientific Computing using SciPy - Linear Regression- Support Vector Machines	**CO3**
7. Scientific Computing using SciPy – Naive Bayes Classification, Decision Trees and Random Forests, Principal Component Analysis, k-Means Clustering.	
8. Data Visualization using Matplotlib – Types of plots such as HISTOGRAM, Scatter Plots, Line, Bar, Pie Chart.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Chirag Shah," A Hands-on Introduction to Data Science", Cambridge University Press, 2020.
2. Stephen Klosterman, "Data Science projects with Python: A case study approach to successful data science projects using Python, pandas and scikit-learn", Packt Publishing Ltd., 2019
3. 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. https://socialresearchmethods.net/kb/statprep.php
2. https://www.nobledesktop.com/learn/python/data-visualization-matplotlib
3. https://www.dataquest.io/blog/python-api-tutorial/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concept of data formation with the help of crawling and usage of APIs
CO2	Apply various Data cleaning, data transformation, data exploration and data visualization techniques in Python programming language.
CO3	Explore and visualize data using various data science tools and python APIs.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2
CO2	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2
CO3	3	3	3	2	2	-	-	2	2	2	-	3	3	3	2

ML1408	MACHINE LEARNING LABORATORY	L	T	P	C
	Common for IT, AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To make use of Data sets in implementing the machine learning algorithms
- To implement the machine learning concepts and algorithms in any suitable language of choice
- To understand the practical aspects of probabilistic graphical models.

LIST OF EXPERIMENTS

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV File	**CO1**
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm. Output a description of the set of all hypotheses consistent with the training examples.	
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample	**CO2**
4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets	
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.	
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.	**CO3**
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library lasses/API	
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library lasses/API in the program.	
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.	
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. Aurelien Geron , “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow : Concepts, Tools, and Techniques to Build Intelligent Systems”, Second Edition, O'Reilly Media
2. Fabio Nelli, “Python Data Analytics with Pandas, Numpy, and Matplotlib”, Second Edition, Apress, 2018
3. Practical Machine Learning with Python: A Problem-Solver's Guide to Building Real-World Intelligent Systems” Dipanjan Sarkar, Raghav Bali, Tushar Sharma, Apress.

WEB REFERENCES

1. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/
2. Web Resources: https://www.anaconda.com/enterprise-machine-learning-getting-started/
3. https://www.tutorialspoint.com/machine_learning_with_python/index.htm

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Update the general and specific boundary for each new example in concept learning
CO2	Develop supervised learning predictive model for general data set
CO3	Ability to apply knowledge representation and machine learning techniques to real world problems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

HS1310	PROFESSIONAL SKILLS LABORATORY	L	T	P	C
	Common for CSE & AI-DS	0	0	2	1

OBJECTIVES

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

LIST OF EXPERIMENTS

UNIT I	**6**
Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language-General awareness of Current Affairs.	**CO1**
UNIT II	**6**
Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language	**CO2**
UNIT III	**6**
Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion; Accepting others' views / ideas; Arguing against others' views or ideas, etc	**CO3**
UNIT IV	**6**
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	**CO4**
UNIT V	**6**
Recognizing differences between groups and teams- managing time managing stress- networking professionally- respecting social protocols understanding career management- developing a long- term career plan making career changes	**CO5**
	TOTAL : 30 PERIODS

REFERENCE BOOKS

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
4. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010
5. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	1	2	3	-	-	2	1	2
CO2	-	1	-	2	-	-	-	-	-	3	-	-	1	-	2
CO3	-	2	-	3	-	-	-	-	1	2	-	-	-	-	2
CO4	-	-	-	-	1	-	-	-	2	2	-	-	-	-	2
CO5	-	2	1	1	2	-	2	-	-	3	-	-	1	2	2

DS1501	OPTIMIZATION FOR DATA ANALYSIS	L	T	P	C
		4	0	0	4

OBJECTIVES

- To use convex sets and convex functions
- To understand Regression analysis
- To learn clustering and classification
- To learn multivariate analysis

UNIT I	CONVEX SETS	9
Iteration principles- Fixed point algorithms- Convex sets and convex cones- Best approximation paradigms- Projection methods in convex feasibility problems- applications to data fusion and image recovery		CO1
UNIT II	**CONVEX FUNCTIONS**	**9**
Convex functions-Conjugation of convex functions-Duality in convex optimization-Sub differential calculus-Sub gradient algorithms for convex feasibility and best approximation-applications in inverse problems		CO2
UNIT III	**REGRESSION ANALYSIS**	**9**
Regression Analysis: Linear Regression-Logistic Regression- Polynomial Regression-Stepwise Regression- Ridge Regression- Lasso Regression- ElasticNet Regression		CO3
UNIT IV	**CLUSTER ANALYSIS AND CLASSIFICATIONS**	**9**
Cluster Analysis: Affinity Propagation- Agglomerative Clustering- BIRCH- DBSCAN- k-Means, Mini-Batch k-Means, Mean Shift, OPTICS, Spectral Clustering, Mixture of Gaissian, Classification Analysis: Naïve Bayes, Stochastic gradient dissent, k-Nearest Neighbors, Random Forest, Support Vector Machine		CO4
UNIT V	**MULTIVARIATE ANALYSIS**	**9**
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. H. H. Bauschke and P. L. Combettes, Convex Analysis and Monotone Operator Theory in Hilbert Spaces, 2nd ed. Springer, New York, 2017
2. Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Introduction to Linear Regression Analysis, Wiley-2017
3. Gareth James**,**Daniela Witten**,**Trevor Hastie**,**Rob Tibshirani , An Introduction to statistical Learning, Springer

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and apply convex sets for data fusion
CO2	Understand and apply convex functions in inverse problems
CO3	Apply regression analysis for forecasting
CO4	Apply clustering and classification to classify the objects
CO5	Understand and apply multivariate analysis

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO2	3	3	2	-	2	-	-	2	2	1	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	1	-	2	3	3	2

DS1502	ADVANCED ARTIFICIAL INTELLIGENCE	L	T	P	C
	Common for AI-DS & AI-ML	3	1	0	3

OBJECTIVES

- To analyze Probabilistic Reasoning for knowledge
- To give understanding of main abstractions of decision making.
- To understand a wide variety of learning algorithms.
- To understand the different ways of designing software agents
- To understand the application of AI namely Robotics

UNIT I	UNCERTAINTY AND REASONING	9
Uncertainty - Basic Probability Notation – Axioms of Probability – Bayes Rule - Probabilistic Reasoning – Bayesian Networks – Semantics – Inference – Other Approaches to Uncertain Reasoning – Dempster Shafer Theory – Fuzzy sets and Fuzzy Logic		CO1
UNIT II	**DECISION MAKING**	**9**
Utility Theory - Utility Functions – Decision Networks – Value of Information – Decision Theoretic Expert Systems – Sequential Decision Problems – Value Iteration – Policy Iteration – Decision Theoretic Agents		CO2
UNIT III	**LEARNING METHODS**	**9**
Learning from Observations - Forms of Learning – Inductive Learning – Learning Decision Trees – Ensemble Learning - Explanation Based Learning – Learning with Complete Data – Naïve Bayes Models – Learning with Hidden Variables – The EM Algorithm – Neural Networks		CO3
UNIT IV	**SOFTWARE AGENTS**	**9**
Architecture for Intelligent Agents – Examples - Agent communication – KQML- KIF – FIPA ACL – Speech Acts - Argumentation among Agents – Trust and Reputation in Multi-agent systems		CO4
UNIT V	**ROBOTICS**	**9**
Robot Hardware – Robotic Perception – Planning to Move, Planning Uncertain Movements – Moving – Robotic Software Architectures – Application Domains		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Russell S and Norvig P, - Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. Gerhard Weiss, - Multiagent Systems: A Modern Approach to Distributed Artificial Intelligence, Second Edition, The MIT Press, 2013.

REFERENCE BOOKS

1. Kaushik, Artificial Intelligence, Cengage Learning, 1st Edition, 2011
2. David L. Poole and Alan K. Mackworth, - Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
3. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008.
4. Nils J. Nilsson,- The Quest for Artificial Intelligence, Cambridge University Press,2009

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Acquire theoretical knowledge about principles for logic-based representation and reasoning
CO2	Develop a decision-making model that utilizes Artificial Intelligence.
CO3	Develop an understanding what is involved in learning models from data.
CO4	Select appropriately from a range of techniques when implementing intelligent systems
CO5	Gain knowledge on the functions of Robots

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO2	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO3	3	3	3	3	3	1	-	-	1	2	2	3	3	3	3
CO4	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3
CO5	3	3	3	3	3	1	-	-	2	2	2	3	3	3	3

DS1503	DATA MINING	L	T	P	C
		3	1	0	3

OBJECTIVES

- Learn data mining concepts understand association rules mining
- Discuss classification algorithms learn how data is grouped using clustering techniques
- To develop the abilities of critical analysis to data mining systems and applications
- To implement practical and theoretical understanding of the technologies for data mining
- To understand the strengths and limitations of various data mining models

UNIT I	INTRODUCTION	9
Introduction, What is Data Mining, Definition, KDD, Challenges, Data Mining Tasks, Data Preprocessing, Data Cleaning, Missing data, Dimensionality Reduction, Feature Subset Selection, Discretization and Binaryzation, Data Transformation; Measures of Similarity and Dissimilarity- Basics		CO1
UNIT II	**ASSOCIATION RULE**	**9**
Problem Definition, Frequent Item Set Generation, The APRIORI Principle, Support and Confidence Measures, Association Rule Generation; APRIOIRI Algorithm, The Partition Algorithms, FP-Growth Algorithms, Compact Representation of Frequent Item Set- Maximal Frequent Item Set, Closed Frequent Item Set		CO2
UNIT III	**CLASSIFICATION**	**9**
Problem Definition, General Approaches to solving a classification problem , Evaluation of Classifiers , Classification techniques, Decision Trees-Decision tree Construction , Methods for Expressing attribute test conditions, Measures for Selecting the Best Split, Algorithm for Decision tree Induction ; Naive-Bayes Classifier, Bayesian Belief Networks; K- Nearest neighbor classification-Algorithm and Characteristics		CO3
UNIT IV	**CLUSTERING**	**9**
Problem Definition, Clustering Overview, Evaluation of Clustering Algorithms, Partitioning Clustering-K-Means Algorithm, K-Means Additional issues, PAM Algorithm; Hierarchical Clustering-Agglomerative Methods and divisive methods, Basic Agglomerative Hierarchical Clustering Algorithm, Specific techniques, Key Issues in Hierarchical Clustering, Strengths and Weakness; Outlier Detection		CO4
UNIT V	**WEB AND TEXT MINING**	**9**
Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining –unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han, Micheline Kamber, Data Mining- Concepts and Techniques, Morgan Kaufmann Publishers, Elsevier, 2 Edition, 2006
2. Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, Introduction to Data Mining, Pearson Education
3. Hongbo Du Cengage , Data mining Techniques and Applications, India Publishing

REFERENCE BOOKS

1. Arun K Pujari, Data Mining Techniques, 3rd Edition, Universities Press
2. T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Data Mining Principles & Applications, Elsevier
3. Vikaram Pudi, P Radha Krishna, Data Mining, Oxford University Press

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Apply suitable data pre-processing methods for the given dataset
CO2	Generate association rules using algorithms like Apriori, Frequent Pattern tree for the given problem
CO3	Analyze the performance of different classification algorithms
CO4	Use clustering techniques such as partitioning, hierarchical, density based for grouping data and processing massive data set
CO5	Classify web pages, extracting knowledge from the web

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	2	1	1	-	-	-	-	1	1	1	3	3	2
CO2	2	3	2	2	1	-	-	-	-	1	1	1	3	3	2
CO3	3	2	2	2	2	-	-	-	-	1	1	1	3	3	2
CO4	3	2	2	2	1	-	-	-	-	1	1	1	3	3	2
CO5	2	2	2	2	1	-	-	-	-	1	1	2	3	3	2

DS1504	EXPLORATORY DATA ANALYSIS	L	T	P	C
		3	1	0	3

OBJECTIVES

- To learn the fundamentals Exploratory Data Analysis
- To understand the theoretical foundation of working with data.
- To learn essential statistical measures
- To understand time-series data and how to perform EDA on it.
- To get knowledge about quality on data analysis.

UNIT I	INTRODUCTION TO EXPLORATORY DATA ANALYSIS	9
Exploratory Data Analysis Fundamentals - Understanding data science - The significance of EDA - Making sense of data - Comparing EDA with classical and Bayesian analysis - Software tools available for EDA - Visual aids for EDA – Types of Charts		**CO1**
UNIT II	**DATA TRANSFORMATION**	**9**
EDA with personal Email - Loading the dataset - Data transformation - Data Analysis - Merging database-style data frames - Transformation techniques - Benefits of Transformation		**CO2**
UNIT III	**DESCRIPTIVE STATISTICS, GROUPING DATASETS**	**9**
Understanding statistics - Measures of central tendency - Measures of dispersion - Grouping Datasets - Understanding groupby() - Data aggregation - Pivot tables and cross-tabulations - Correlation - Types of analysis - multivariate analysis using the Titanic dataset		**CO3**
UNIT IV	**TIME SERIES ANALYSIS, MODEL DEVELOPMENT AND EVALUATION**	**9**
Understanding the time series - Time Series Analysis with Open Power System - Hypothesis Testing and Regression - Hypothesis testing - p-hacking - Understanding regression - Model development and evaluation		**CO4**
UNIT V	**MACHINE LEARNING, EDA ON WINE QUALITY DATA ANALYSIS**	**9**
Types of machine learning - Supervised learning - Unsupervised learning - Reinforcement Learning - Unified machine learning workflow - Disclosing the wine quality dataset - Analyzing red wine - Analyzing white wine – Model Development and Evaluation		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python: Perform EDA techniques to understand, summarize, and investigate your data”, First Edition, Packt Publication, 2020.

REFERENCE BOOKS

1. Allen B. Downey, “Think Stats: Exploratory Data Analysis”, Second Edition, Oreilly Publications, 2014.
2. Glenn J. Myatt and Wayne P. Johnson, “Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining”, Second Edition, Wiley Publications, 2014.
3. Glenn J. Myatt and Wayne P. Johnson, “Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods and Applications”, Wiley Publications, 2009.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Understand the fundamental concepts of exploratory data analysis using Python
CO2	Implement EDA with personal mail and to work with data transformation
CO3	Understand the variance and standard deviation of datasets
CO4	Describe the visualization and analysis of time series and survival calculations.
CO5	Understand different types of machine learning and to apply all the techniques learnt to perform EDA on a wine quality dataset.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	2	3	3	2

DS1507	DATA PREPARATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ Learn pre-processing method for multi-dimensional data
- ❖ Practice on data cleaning mechanisms
- ❖ Learn various data exploratory analysis
- ❖ Develop the visualizations for clusters or partitions

LIST OF EXPERIMENTS

1. DATA PRE-PROCESSING AND DATA CUBE Data pre-processing methods on student and labour datasets Implement data cube for data warehouse on 3-dimensional data	**CO1**
2. DATA CLEANING Implement various missing handling mechanisms, Implement various noisy handling mechanisms	
3. EXPLORATORY ANALYSIS Develop k-means and MST based clustering techniques, Develop the methodology for assessment of clusters for given dataset	**CO2**
4. ASSOCIATION ANALYSIS Design algorithms for association rule mining algorithms	
5. HYPTOTHYSIS GENERATION Derive the hypothesis for association rules to discovery of strong association rules; Use confidence and support thresholds	
6. TRANSFORMATION TECHNIQUES Construct Haar wavelet transformation for numerical data, Construct principal component analysis (PCA) for 5-dimensional data.	
7. DATA VISUALIZATION Implement binning visualizations for any real time dataset, Implement linear regression techniques	**CO3**
8. CLUSTERS ASSESSMENT Visualize the clusters for any synthetic dataset, Implement the program for converting the clusters into histograms	
9. HIERARCHICAL CLUSTERING Write a program to implement agglomerative clustering technique, write a program to implement divisive hierarchical clustering technique	
10. SCALABILITY ALGORITHMS Develop scalable clustering algorithms, Develop scalable a priori algorithm	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. SinanOzdemir, “Principles of Data Science”, Packt Publishers, 2016.

WEB REFERENCES

1. https://paginas.fe.up.pt/~ec/files_1112/week_03_Data_Preparation.pdf
2. https://socialresearchmethods.net/kb/statprep.php
3. https://www.quest.com/solutions/data-preparation-and-analysis/

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply data pre-processing and data cleaning methods on multidimensional dataset
CO2	Apply various data exploratory analysis on the given dataset
CO3	Apply clustering algorithm to spilt the dataset and visualization technique to retrieve insights on the dataset

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	1	1	-	-	2	2	2	-	2	3	3	2

DS1508	ADVANCED ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
	Common for AI-DS & AI-ML	0	0	4	2

OBJECTIVES

- To be able to reason under uncertainty of the real-world.
- To understand supervised learning techniques.
- To increase knowledge about learning with hidden variables.
- To understand how to use natural language processing.
- To get familiarized with basics of robotics.

LIST OF EXPERIMENTS

1. Implement a Python program of automatic Tic Tac Toe game using random number.	**CO1**
2. Apply Bayes' Rule to a scenario of drug screening, which is a mandatory testing for federal or many other jobs which promise a drug-free work environment.	
3. Demonstrate the application of Bayesian Network for the Monty Hall Problem. The Monty Hall problem is a brain teaser, in the form of a probability puzzle. Assume that you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?	
4. Write a Python program to create a fuzzy control system which models how you might choose to tip at a restaurant. When tipping, you consider the service and food quality, rated between 0 and 10. You use this to leave a tip of between 0 and 25%.	
5. Formulate a decision tree, which is applicable in the field of medical sciences that will help predict whether or not a patient has diabetes.	**CO2**
6. Implement Adaptive Boosting in Python for a simple fruit classification problem. Consider classification of the fruits into oranges or apples. The characteristics that are provided for the fruits to be classified are weight and size (diameter). Classify a new fruit as either apple or orange just based on the data on the size and weights.	
7. For a coin toss example with incomplete information, we have missing data and the problem of estimating θ, where θ is the probability of heads or tails is harder to solve. Apply Expectation Maximization (EM) Algorithm to start with a guess for θ, then calculate z, then update θ using this new value for z, and repeat till convergence. The label of the coin is indicated by z.	
8. Perform text classification for a real-world example. Consider a model capable of predicting whether a given movie review is positive or negative. Use people's sentiments which are classified into different categories and based upon the text classification give either a positive review or a negative review.	**CO3**
9. Given a robot which can only move in four directions, UP (U), DOWN (D), LEFT (L), and RIGHT®. Given a string consisting of instructions to move. Output the coordinates of a robot after executing the instructions. Initial position of robot is at origin (0, 0).	
10. A robot moves in a plane starting from the original point (0, 0). The robot can move toward UP, DOWN, LEFT and RIGHT with a given steps. Write a program to compute the distance from current position after a sequence of movement and original point. If the distance is a float, then just print the nearest integer.	

TOTAL : 60 PERIODS

REFERENCE BOOKS

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach, Prentice Hall, Third Edition, 2009.
2. Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

WEB REFERENCES

1. https://www.tutorialspoint.com/artificial_intelligence_with_python/index.htm
2. https://machinelearningmastery.com/uncertainty-in-machine-learning/
3. https://learn-robotics.com/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Approach a real-world problem, which is uncertain and provide appropriate reasoning.
CO2	Develop solutions using supervised learning techniques and know how to deal with problems with hidden variables.
CO3	Use natural language processing and program basics of robotics.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO2	3	3	3	3	2	2	1	1	2	2	2	3	3	3	3
CO3	3	3	3	3	3	2	1	1	2	2	2	3	3	3	3

DS1601	MODERN SCRIPTING LANGUAGES	L	T	P	C
		3	1	0	3

OBJECTIVES

- To become skilled at JavaScript and JQuery.
- To learn the concepts of Angular JS.
- To understand the basic framework of Node JS.
- To learn the various Features of PowerShell.
- To become familiar with the concepts of LINQ

UNIT I	JAVASCRIPT AND JQUERY	9
Introduction to JavaScript - Syntax - Variables and data types -JavaScript Control Statements - Functions -Objects - Fundamentals of JQuery –JQuery selectors - Traversing - Manipulators – Events		CO1
UNIT II	**ANGULAR JS**	**9**
Introduction to Angular JS –Directives –Expression –controllers –scope-events –services – Filters – Modules – Forms –Validation –Exception Handling		CO2
UNIT III	**NODE JS**	**9**
Introduction to Node JS – NPM – Callbacks –Events- Express Framework –Database Connectivity		CO3
UNIT IV	**POWER SHELL**	**9**
Introduction to Power shell –Variables –Operators –Arrays - Conditional Statements – Looping Statements Regular Expressions –File Operations		CO4
UNIT V	**LINQ**	**9**
Introduction to LINQ –Query Operators –SQL –XML – Objects –XML –Entities		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. "HTML 5 Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP & jQuery Black Book", Kogent Learning Solutions Inc., 2011
2. Pedro Teixeira, "Professional Node.js", John Wiley & sons, Inc., 2013

REFERENCE BOOKS

1. Valeri Karpov & Diego Netto, "Professional Angular JS", publication: John Wiley & sons, Inc., 2015
2. Bruce Payette, "Windows Powershell in Action", Manning Publication, 2011.
3. Fabrice Marguerie, Steve Eichert, Jim Wooley, "LINQ in Action", Manning Publication, 2008

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply JavaScript and JQuery to solve problems
CO2	Explore the Angular JS concepts
CO3	Understand and analyze the Node JS framework
CO4	Understand and analyze the Node JS framework
CO5	Understand LINQ Scripting language

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO2	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO3	2	2	3	1	1	-	-	1	-	-	1	2	2	2	2
CO4	2	2	3	1	1	-	-	1	-	-	1	2	3	2	2
CO5	2	2	3	1	1	-	-	1	-	-	1	2	2	2	2

DS1602	COMPUTATIONAL LINGUISTICS	L	T	P	C
		3	1	0	3

OBJECTIVES

- Learn about expressing words
- Learn how to translate text to speech
- Learn the process of analysing a string of symbols
- Analyse the meaning of the word with and without considering the context
- Learn how to automatically extracting structured information

UNIT I	WORDS	9
Regular Expressions and Automata, Words and Transducers, N-grams, Part-of-Speech Tagging, Hidden Markov and Maximum Entropy Models		CO1
UNIT II	**SPEECH**	**9**
Phonetics, Speech Synthesis, Automatic Speech Recognition, Speech Recognition, Advanced Topics, Computational Phonology		CO2
UNIT III	**SYNTAX**	**9**
Formal Grammars of English, Syntactic Parsing, Statistical Parsing, Features and Unification Language and Complexity		CO3
UNIT IV	**SEMANTICS AND PRAGMATICS**	**9**
The Representation of Meaning, Computational Semantics, Lexical Semantics, Computational Lexical Semantics, Computational Discourse		CO4
UNIT V	**APPLICATIONS**	**9**
Information Extraction, Question Answering and Summarization, Dialog and Conversational Agents, Machine Translation		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing, Second Edition

REFERENCE BOOKS

1. Ralph Grishman, Computational Linguistics: An Introduction, Studios in Natural Language Processing
2. Roland Hausser, Foundations of Computational Linguistics, Springer, Third Edition

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply regular expression to describe the word
CO2	Translate text to speech
CO3	Analyze the string of symbols
CO4	Analyze the meaning of the word with and without the context
CO5	Extract structured information automatically

MAPPING OF COs WITH POs AND PSOs													
COs	**PROGRAM OUTCOMES (POs)**										**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	1	-	-	1	-	-	1	1	3
CO2	3	2	2	1	1	-	-	1	-	-	1	1	3
CO3	3	2	2	1	1	-	-	1	-	-	1	1	3
CO4	3	2	2	1	1	-	-	1	-	-	1	1	3
CO5	3	2	2	1	1	-	-	1	-	-	1	1	3

DS1603	DATA VISUALIZATION	L	T	P	C
	Common to EEE (Elective)	3	1	0	3

OBJECTIVES

- To understand how accurately represent voluminous complex data set in web and from other data sources
- To understand the methodologies used to visualize large data sets
- To understand the process involved in data visualization and security aspects involved in data visualization

UNIT I	INTRODUCTION	9
Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.		CO1
UNIT II	**VISUALIZING DATA METHODS**	**9**
Mapping - Time series - Connections and correlations - Scatterplot maps - Trees, Hierarchies and Recursion - Networks and Graphs, Info graphics		CO2
UNIT III	**VISUALIZING DATA PROCESS**	**9**
Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Advanced Web Techniques, using a Database, Dealing with a Large Number of Files. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.		CO3
UNIT IV	**INTERACTIVE DATA VISUALIZATION**	**9**
Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3, .js, tablo.		CO4
UNIT V	**SECURITY DATA VISUALIZATION**	**9**
Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems - Creating security visualization system.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Scott Murray, “Interactive data visualization for the web”, O‟Reilly Media, Inc., 2013.

REFERENCE BOOKS

1. Ben Fry, “Visualizing Data”, O‟Reilly Media, Inc., 2007.
2. Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”, No Starch Press Inc, 2007.
3. Alberto Cairo, “The Functional Art: An introduction to information graphics and visualization”, New Riders, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design and create data visualizations.
CO2	Design and use various methodologies present in data visualization
CO3	Identify opportunities for application of data visualization in various domains.
CO4	Design and process the data for Virtualization.
CO5	Discuss the process involved and security issues present in data visualization

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO2	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO3	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO4	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2
CO5	3	3	3	3	2	2	2	2	2	2	2	1	3	3	2

DS1604	DATA ANALYTICS	L	T	P	C
		3	1	0	3

OBJECTIVES

- To learn the fundamentals of data science and big data.
- To gain in-depth knowledge on descriptive data analytical techniques.
- To gain knowledge to implement simple to complex analytical. Algorithms in big data frameworks.
- To develop programming skills using required libraries and packages to perform data analysis in Python.
- To understand and perform data visualization, web scraping, machine learning and natural language processing using various Data Science tools.

UNIT I	INTRODUCTION TO BIGDATA	9
Introduction to Big Data – Characteristics of Data – Evolution of Big Data – Big Data Analytics – Classification of Analytics – Top Challenges Facing Big Data – Importance of Big Data Analytics – Data Analytics Tools. Data Collections: Types of Data Sources - Sampling - Types of Data Elements - Visual Data Exploration and Exploratory - Statistical Analysis - Missing Values - Outlier Detection and Treatment - Standardizing Data - Categorization - Weights of Evidence Coding - Variable Selection – Segmentation.		**CO1**
UNIT II	**DESCRIPTIVE DATA ANALYTICS**	**9**
Types of Data Analysis – Descriptive, Diagnostic, Predictive and Prescriptive. Mean, Median and Mode – Standard Deviation and Variance – Probability – Probability Density Function – Types of Data Distribution – Percentiles and Moments – Correlation and Covariance – Conditional Probability – Bayes' Theorem – Introduction to Univariate, Bivariate and Multivariate Analysis – Dimensionality Reduction using Principal Component Analysis and LDA – Dimensionality Reduction using Principal Component Analysis and Linear Discriminant Analysis (LDA) – Principal Component Analysis (PCA).		**CO2**
UNIT III	**PREDICTIVE DATA ANALYTICS**	**9**
Linear Regression – Polynomial Regression – Multivariate Regression – Multi Level Models– Data Warehousing Overview – Bias/Variance Trade Off – K Fold Cross Validation – Data Cleaning and Normalization – Cleaning Web Log Data – Normalizing Numerical Data – Detecting Outliers – Introduction to Supervised and Unsupervised Learning – Reinforcement Learning – Dealing with Real World Data – Machine Learning Algorithms –Clustering –Python Based Application.		**CO3**
UNIT IV	**DATA ANALYTICS FRAMEWORKS**	**9**
Introducing Hadoop –Hadoop Overview – RDBMS versus Hadoop – HDFS (Hadoop Distributed File System): Components and Block Replication – Processing Data with Hadoop – Introduction to MapReduce – NoSQL – MongoDB: RDBMS Vs MongoDB – Mongo DB Database Model – Data Types and Sharding – Introduction to Hive – Hive Architecture – Hive Query Language (HQL). PIG – Introduction to PIG.		**CO4**
UNIT V	**DATA STREAMS AND VISUALIZATION**	**9**
Mining Data Streams – Stream Data Model – Sampling Data in stream- Filtering Stream – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window. Visual data analysis techniques-Interaction Techniques-Systems and applications -Analyzing big data with twitter- Big data for E-Commerce-Big data for blogs.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Frank Pane, “Hands On Data Science and Python Machine Learning”, Packt Publishers, 2017.
2. Baesens, Bart, “Analytics in a big data world : the essential guide to data science and its applications”.
3. Seema Acharya, Subhashini Chellapan, “Big Data and Analytics”, Wiley, 2015.
4. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets “, 2012.

REFERENCE BOOKS

1. Alberto Boschetti, Luca Massaron, “Python Data Science Essentials”, Packt Publications, 2nd Edition, 2016.
2. DT Editorial Services, Big Data, Black Book, Dream Tech Press, 2015. 3. Yuxi (Hayden) Liu, “Python Machine Learning”, Packt Publication, 2017.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunity in Huge Data Streams with advanced analytics, John Wiley & Sons, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify the real-world business problems and model with analytical solutions.
CO2	Solve analytical problem with relevant mathematics background knowledge.
CO3	Convert any real-world decision-making problem to hypothesis and apply suitable Statistical testing.
CO4	Write and demonstrate simple applications involving analytics using Hadoop and MapReduce.
CO5	Use open-source frameworks for modeling and storing data and visualize using Python.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1607	DATA VISUALIZATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- Understand how to apply ggplot for visualizing the data
- Understand how to visualize single variable
- Understand visualizing two or more variables
- Learn about customizing the plots with color and labels

LIST OF EXPERIMENTS

1. The built-in R data set quakes gives the locations of earthquakes off of Fiji in the 1960's. Create a plot of the locations of these earthquakes, showing depth with color and magnitude with size	CO1
2. Create a boxplot of highway mileage for each different cylinder in mtcars, and display on one plot with highway mileage on the y-axis and cylinder on the x-axis	
3. Create a barplot of the word lengths of the words in the data set, faceted by novel using austen data set from the fosdata package	
4. The pres_election data set gives voting results from the 2010-2016 U.S. presidential elections. Produce five bar charts, one for each election, that show the total number of votes received by each political party. Use facet_wrap to put all five charts into the same visualization.	
5. The pres_election data set gives voting results from the 2010-2016 U.S. presidential elections. Produce five bar charts, one for each election, that show the total number of votes received by each political party. Use facet_wrap to put all five charts into the same visualization.	
6. Create a scatterplot of highway mileage versus city mileage colored by the number of cylinders, using the mtcars data set. Experiment using categorical and sequential coloring.	CO2
7. In Emma, restrict to words that have non-zero sentiment score. Create a scatterplot of the percentage of words that have a positive sentiment score versus chapter. Add a line using geom_line or geom_smooth and explain your choice using austen data set from the fosdata package	
8. Make a scatterplot showing CO2 uptake as a function of concentration level for the built-in data set CO2. Include a smoothed fit line and color by Type. Facet your plot to one plot for each Plant	
9. Consider the ecars data set create a visualization showing scatterplots with the chargeTimeHrs variable on the x axis and the kwhTotal variable on the y axis. Facet your visualization with one plot per day of week and platform. Remove the web platform cars, so you have 14 facets in two rows and seven columns. Be sure your weekdays display in a reasonable order	
10. Consider the scotland_births data set in the fosdata package. This data set contains the number of births in Scotland by age of the mother for each year from 1945-2019. a. Create a line plot of births by year from 1945-2019 for each age group represented in the data. b. Highlight and color ages 20 and 30, and provide meaningful labels and titles	CO3

11. Consider the frogs data set in the fosdata package. This data was used to argue that a new species of frog had been found in a densely populated area of Bangladesh. Create a scatterplot of head length distance from tip of snout to back of mandible versus forearm length distance from corner of elbow to proximal end of outer palmar metacarpal tubercle, colored by species.

12. Use the babynames data set from the babynames package
    a. Make a line graph of the total number of babies of each sex versus year
    b. Make a line graph of the number of different names used for each sex versus year
    c. Make a line graph of the total number of babies with your name versus year. If your name doesn't appear in the data, use the name "Alexa"
    d. Make a line graph comparing the number of boys named Bryan and the number of boys named Brian from 1920 to the present

13. Use the Batting data set from the Lahman package, gives the batting statistics of every player who has played baseball from 1871 through the present day
    a. Create a scatterplot of the number of doubles hit in each year of baseball history.
    b. Create a scatterplot of the number of doubles hit in each year, in each league. Show only the leagues 'NL' and 'AL', and color the NL blue and the AL red
    c. Create boxplots for total runs scored per year in the AL and the NL from 1969 to the present
    d. Create a histogram of lifetime batting averages (H/AB) for all players who have at least 1000 career AB's.

FOR DATASET : Find Open Datasets and Machine Learning Projects | Kaggle

TOTAL : 60 PERIODS

WEB REFERENCES

1. Chapter 7 Data Visualization with ggplot | Foundations of Statistics with R (slu.edu)
2. https://bookdown.org

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop plots such as histogram, bar plots, density plots, box plots and QQ plots by using single variable
CO2	Apply multivariable to develop plot such as scatter plot, line graphs, and faceting to visualize the data
CO3	Customize the plots with colors, labels and themes, text annotations, and highlighting

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2
CO2	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2
CO3	3	3	3	3	2	1	1	2	2	1	1	2	3	3	2

DS1701	NEURO-FUZZY COMPUTING	L	T	P	C
		3	1	0	3

OBJECTIVES

- Get familiarized with different architectures and training algorithms of neural networks.
- Get exposed to the various neural modelling and control techniques with case study using simulation tool box.
- Gain Knowledge on fuzzy set theory and fuzzy rules.
- Able to design and implement the fuzzy logic controller with case study using simulation tool box.
- Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box

UNIT I	ARTIFICIAL NEURAL NETWORK	9
Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perception – Limitation – Multilayer perception – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning		CO1
UNIT II	**NEURAL NETWORKS FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture–Model validation – Control of non-linear systems using ANN – Direct and indirect Neuro control schemes – Adaptive Neuro controller – Familiarization with neural network toolbox		CO2
UNIT III	**FUZZY SET THEORY**	**9**
Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions		CO3
UNIT IV	**FUZZY LOGIC FOR MODELING AND CONTROL**	**9**
Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox		CO4
UNIT V	**HYBRID CONTROL SCHEMES**	**9**
Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to support vector machine – Particle swarm optimization – Case study – Familiarization with ANFIS toolbox		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs, N.J., 1992
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 2000.

REFERENCE BOOKS

1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, Addison Wesley Publishing Company Inc. 1989
2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press, 1992.
3. EthemAlpaydin, “Introduction to Machine learning (Adaptive Computation and Machine Learning series)’, MIT Press, Second Edition, 2010.
4. Zhang Huaguang and Liu Derong, “Fuzzy Modeling and Fuzzy Control Series: Control Engineering”, 2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand basics of deep learning
CO2	Implement various deep learning models
CO3	Realign high dimensional data using reduction techniques
CO4	Analyze optimization and generalization in deep learning
CO5	Explore the deep learning applications

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1702	TEXT ANALYTICS	L	T	P	C
		3	1	0	3

OBJECTIVES

- To get introduced to language processing technologies for processing the text data.
- To get introduced to Text analytics concepts and framework.
- To acquire knowledge on text data analytics and its classification using language models.
- To understand the need of Text similarity analysing and Clustering algorithms.
- To learn the theoretical techniques, tools and applications of text analytics.

UNIT I	INTRODUCTION TO NATURAL LANGUAGE PROCESSING	9
Natural Language Processing - Linguistic Background - Language syntax and structure - Grammar - Language Semantics - Mathematical Foundations - Morphological Analysis - Boundary Determination- Reading unstructured data - Representing text data - Text Analysis Framework.		CO1
UNIT II	**PROCESSING AND UNDERSTANDING TEXT**	**9**
Text Tokenization - Sentence Tokenization - Word Tokenization - Text Normalization - Cleaning Text -Tokenizing Text - Removing Special Characters - Expanding Contractions - Case Conversions - Removing Stop words - Correcting Words - Stemming - Lemmatization - Understanding Text Syntax and Structure - Installing Necessary Dependencies - Important Machine - Part of speech (POS) tagging - Shallow parsing - Dependency-based parsing - Constituency-based parsing.		CO2
UNIT III	**TEXT CLASSIFICATION**	**9**
Automated text classification - Text Normalization - Bag of words Model - TF-IDF Model - Classification Algorithms - Multinomial Naive Bayes - Support Vector Machines - Evaluating Classification Models - Building a Multi-Class Classification System - Application and uses.		CO3
UNIT IV	**TEXT SIMILARITY AND CLUSTERING**	**9**
Important concepts - Analysing Term Similarity - Analysing Document Similarity - Document Clustering - K Means - Affinity Propagation - Ward's Agglomerative Hierarchical Clustering - Semantic Analysis - Exploring WordNet - Word Sense Disambiguation - Named Entity Recognition - Analysing Semantic Representation - Proposition Logic - First Order Logic		CO4
UNIT V	**TEXT ANALYTICS APPLICATION**	**9**
Tools – Natural Language Tool kit, Apache OpenNLP. Applications of Text Analytics – Applications in Social media - Life science - Legal Text–Visualization -Case studies-Sentimental Analysis - Sentiment Analysis of IMDB Movie Reviews - Setting up Dependencies - Preparing Datasets - Supervised Machine Learning Technique - Unsupervised Lexicon - based Techniques - Comparing Model Performances.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.
2. Dipanjan Sarkar "Text Analytics with Python-A Practical Real-World Approach to Gaining Actionable Insights from Your Data", Apress ,2016

REFERENCE BOOKS

1. Steven Struhl, “Practical Text Analytics: Interpreting Text and Unstructured Data for Business Intelligence”, Kogan Page, 2015.
2. Matthew A. Russell, “Mining the Social Web”, O'Reilly Media, 2013. 4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, 1 st Edition, O'Reilly Media, 2009.
3. James Allen, “Natural Language Understanding”, Second Edition, 2003, Pearson Education.
4. Daniel Jurafsky & James H.Martin, “ Speech and Language Processing”, Pearson Education (Singapore) Pte. Ltd., 2002.
5. Benjamin Bengfort, Rebecca Bilbro, Tony Ojeda ,” Applied Text Analysis with Python” ,1 st Edition, O'Reilly Media,2018

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain basic knowledge over language processing technologies for processing the text data.
CO2	Extract the key information from Text data and process it at semantic level.
CO3	Analyze the text content to provide predictions related to a specific domain using language models.
CO4	Interpret the results, gain insights, and recommend possible actions from analytics performed on text data
CO5	Perform a variety of NLP tasks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

DS1703	COMPUTER VISION	L	T	P	C
		3	1	0	3

OBJECTIVES

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough, Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques and motion analysis.
- To study some applications of computer vision algorithms.

UNIT I	IMAGE PROCESSING FOUNDATIONS	9
Review of image processing techniques – classical filtering operations – thresholding techniques - edge detection techniques – corner and interest point detection – mathematical morphology – texture.		CO1
UNIT II	**SHAPES AND REGIONS**	**9**
Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.		CO2
UNIT III	**HOUGH TRANSFORM**	**9**
Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.		CO3
UNIT IV	**3D VISION AND MOTION**	**9**
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.		CO4
UNIT V	**APPLICATIONS**	**9**
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application- In-vehicle vision system- locating roadway – road markings – identifying road signs – locating pedestrians.		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Baggio D L et al., Mastering OpenCV with Practical Computer Vision Projects, Packt Publishing, 2012.

REFERENCE BOOKS

1. E. R. Davies, —Computer & Machine Vision‖, Fourth Edition, Academic Press, 2012.
2. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing images‖, O'Reilly Media, 2012.
3. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision‖, Third Edition, Academic Press, 2012.
4. R. Szeliski, —Computer Vision: Algorithms and Applications‖, Springer 2011.
5. Simon J. D. Prince, —Computer Vision: Models, Learning, and Inference‖, Cambridge University Press, 2012.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement fundamental image processing techniques required for computer vision.
CO2	Implement boundary tracking techniques and perform shape analysis
CO3	Apply Hough Transform for line, circle, and ellipse detections.
CO4	Apply 3D vision techniques and implement motion related techniques.
CO5	Develop applications using computer vision techniques.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	2	3
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	3

DS1704	BIG DATA MANAGEMENT	L	T	P	C
		3	1	0	3

OBJECTIVES

- To Understand the differences and benefits of in-memory data management.
- To Understand the execution flow of a distributed query.
- To Identify the difficulties of scalability and parallelization.
- To Design a distributed database using NoSQL tools.
- To Produce a functional program to process Big Data in a Cloud environment.
- To Manage and process a Data Stream.
- To Design the architecture of a Big Data management system.

UNIT I	INTRODUCTION	9
Introduction to Big Data, Cloud Computing, Scalability - Big Data Design - Polyglot systems; Schema less databases; Key-value stores; Wide-column stores; Document-stores		CO1
UNIT II	**DATA MANAGEMENT**	**9**
Distributed Data Management: Transparency layers; Distributed file systems; File formats; Fragmentation; Replication and synchronization; Sharding; Consistent hash; LSM-Trees. In-memory Data Management: NUMA architectures; Columnar storage; Late reconstruction; Light-weight compression		CO2
UNIT III	**DATA PROCESSING**	**9**
Distributed Data Processing: Distributed Query Processing; Sequential access; Pipelining; Parallelism; Synchronization barriers; Multitenancy; Map Reduce; Resilient Distributed Datasets; Spark. Stream management and processing: One-pass algorithms; Sliding window; Stream to relation operations; Micro-batching; Sampling; Filtering; Sketching		CO3
UNIT IV	**DATA ANALYTICS FRAMEWORKS**	**9**
Big Data Architectures: Centralized and Distributed functional architectures of relational systems; Data Warehousing architectures; Service Oriented Architecture; Lambda architecture		CO4
UNIT V	**NOSQL DATA MANAGEMENT FOR BIG DATA**	**9**
Introduction to Big Data Storage Platforms for Large Scale Data Storage, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Introduction to Zookeeper and Paxos, Introduction to Cassandra, Cassandra Internals, Introduction to HBase, HBase Internals. NoSQL Databases: Schema-less Models: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases-Hive – Sharding. Bigtable: a distributed storage system for structured data.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Mining of massive datasets - Leskovec, J.; Rajaraman, A.; Ullman, J.D, Cambridge University Press, 2020. ISBN: 9781108476348
2. In-memory data management - Plattner, H.; Zeier, A, Springer, 2012. ISBN: 9783642295744
3. Principles of distributed database systems - Özsu, M.T.; Valduriez, P, Springer, 2020. ISBN: 9783030262525.
4. NoSQL distilled: a brief guide to the emerging world of polygot persistence - Sadalage, P.J.; Fowler, M, Addison-Wesley, 2013. ISBN: 9780321826626

REFERENCE BOOKS

1. Zaharia, M ,An architecture for fast and general data processing on large clusters -, ACM Books, 2016.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Identify the real-world business problems and model with analytical solutions.
CO2	Understand the differences and benefits of in-memory data management.
CO3	Understand the execution flow of a distributed query.
CO4	Design the architecture of a Big Data management system.
CO5	Design a distributed database using NoSQL tools

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

DS1707	NEURO-FUZZY COMPUTING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- ❖ Understand Fuzzy concepts
- ❖ Learn neural networks with back propagation and without preparation
- ❖ Learn the operators of genetic algorithms
- ❖ Practice on crisp partitions.

LIST OF EXPERIMENTS

1. Implementation of Perceptron.	**CO1**
2. Implementation of Perceptron Rule	
3. Implementation of Artificial Neural Networks	
4. Implementation of Fuzzy Sets	**CO2**
5. Implementation of Covariance	
6. Data Fitting by Regression	
7. Implementation of Crisp Model	
8. Implementation of Logic Gates	**CO3**
9. Implementation of Genetic Algorithms	
10. Implementation of Classification Algorithm	

TOTAL : 60 PERIODS

REFERENCE BOOK

1. D.K Prathikar, —Soft Computing‖, Narosa Publishing House, New Delhi, 2008

WEB REFERENCES

1. http://mirlab.org/jang/book/

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the implementation of Neural Network algorithms.
CO2	Design solutions for complex problems using Fuzzy set.
CO3	Design and apply Genetic and Classification Algorithms

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3

SEMESTER V
PROFESSIONAL ELECTIVE – I

DS1511	XML AND WEB SERVICES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basics of XML.
- To learn XML based technologies and SOAP
- To evaluate the technologies behind Web Services
- To learn to work with RESTful web services
- To implement and consume RESTful web services

UNIT I	INTRODUCTION	9
Role of XML - XML and the Web - XML Language Basics - SOAP - Web Services - Revolutions of XML - Service Oriented Architecture		CO1
UNIT II	**SOAP**	**9**
Overview Of SOAP - HTTP - XML-RPC - SOAP: Protocol - Message Structure - Intermediaries - Actors - Design Patterns And Faults - SOAP With Attachments		CO2
UNIT III	**WEB SERVICE TECHNOLOGIES**	**9**
Overview - Architecture - Key Technologies -UDDI - WSDL - ebXML - SOAP And Web Services In E-Com -Overview Of .NET And J2EE		CO3
UNIT IV	**INRTODUCTION TO RESFUL WEBSERVICES**	**9**
Kinds of Things on the Programmable Web - HTTP: Documents in Envelopes - Method Information - Scoping Information - The Competing Architectures - Technologies on the Programmable Web -Leftover Terminology - Web Services are Web Sites - del.icio.us: The Sample Application - Making the Request: HTTP Libraries - Processing the Response: XML Parsers -JSON Parsers: Handling Serialized Data - Clients Made Easy with WADL		CO4
UNIT V	**DEVELOPING AND CONSUMING RESTFUL WEB SERVICES**	**9**
9 Introducing the Simple Storage Service -Object-Oriented Design of S3 - Resources -HTTP Response Codes Resource URIs - Addressability - Statelessness - Representations - Links and Connectedness - The Uniform Interface –A Service Implementation.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Frank. P. Coyle, XML, Web Services And The Data Revolution, Pearson Education, 2002.
2. Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly Media, 2007.
3. Lindsay Bassett, Introduction to JavaScript Object Notation, O'Reilly Media, 2015.

REFERENCE BOOKS

1. Ramesh Nagappan, Robert Skoczylas and Rima Patel Sriganesh, "Developing Java Web Services", Wiley Publishing Inc., 2004.
2. Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services", Pearson Education, 2004.
3. McGovern, et al., "Java Web Services Architecture", Morgan Kaufmann Publishers,2005

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand how to write XML documents
CO2	Apply XML based technologies and SOAP
CO3	Analyze the structure and implement Web Services
CO4	Understand and use RESTful web services
CO5	Create and Consume RESTful web service using JSON

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO2	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO3	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO4	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1
CO5	2	1	1	1	1	-	-	1	-	-	1	1	2	2	1

DS1512	R PROGRAMMING FOR DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn basics and importance of R programming
- To define and manipulate R data structures, including vectors, factors, lists, and data frames.
- To read, write, and save data files and to tabulate the data using Factors
- To create artful graphs to visualize complex data sets and functions and to query the database
- To perform statistical analysis on variety of data

UNIT I	INTRODUCTION TO R PROGRAMMING	9
History and overview of R - Install and configuration of R programming environment - Starting and ending R, R as a scientific calculator, handling package, workspace, inspecting variables, operators and expressions in R- Conditions and Loops –Functions: built-in and user-defined functions.		CO1
UNIT II	**DATA STRUCTURES AND DATA MANIPULATION**	**9**
Vectors - Combining multiple vectors - Arrays and Matrices, Lists – Creating lists - List operations – Applying functions to lists – Recursive lists, Data frames–Creating and Accessing Data frames - Merging Data Frames – Applying functions to Data frames, Data Transformation, Outlier Detection, String Operations - Regular Expressions - Date and Time Format		CO2
UNIT III	**WORKING WITH DATA**	**9**
Reading CSV, Excel, and Built-in Datasets - Reading Text Files - Writing and Saving to Files - HTTP Request and REST API - Web Scraping: Working with Messy Data - Renaming Columns(Variable Names) - Attaching / Detaching - Tabulating Data: Constructing Simple Frequency Tables - Ordering Factor Variables		CO3
UNIT IV	**GRAPHICS AND VISUALIZATION**	**9**
Visualize data using ggplot2package - Apply themes from ggthemes to refine and customize charts and graphs - Scatter Plots - Box Plots - Scatter Plots and Box and-Whisker Plots – Histograms - Building data graphics for dynamic reporting. Data Querying - Writing SQL statements - Using the Select, From, Where, Is, Like, Order By, Limit, Max, Min SQL functions.- Data wrangling with dplyr.		CO4
UNIT V	**STATISTICAL ANALYSIS**	**9**
Importing data files, exporting data, outputting results, exporting - Performing data analysis tasks: R commands for descriptive statistics, data aggregation, representation of multivariate data, code factorization and optimization, statistical libraries in R.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Garrett Grolemund and Hadley Wickham, R for Data Science Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, 2016
2. Normal Maltoff, The Art of R programming O'Reilly Media, 2011

REFERENCE BOOKS

1. Purohit S. G., Gore S. D., Deshmukh S. K., “Statistics using R”, Narosa
2. Rizzo, M. L., “Statistical Computing with R”, Boca Raton, FL: Chapman & Hall/CRC Press
3. Learning resources:
   - R Project: http://www.r-project.org/
   - RStudio: http://www.rstudio.com
   - Quick-R: http://www.statmethods.net/

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand basics and importance of R programming
CO2	Understand data structures including vectors, factors, lists, and data frames.
CO3	Analyse the data files and to tabulate the data using Factors
CO4	Visualize complex data sets and functions and to query the database
CO5	Analyse and predict statistical data on variety of datasets

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	1	2	2	2	3	3	2

DS1513	PROLOG PROGRAMMING FOR ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the background and basics of Prolog programming
- To learn the programming constructs to develop solution for specific problems
- To handle input and output operation through prolog and implementing data structure concepts
- To use prolog for artificial intelligence
- To apply prolog for machine learning, game playing and meta programming

UNIT I	AN OVERVIEW OF PROLOG	9
An Example program: defining family relations – extending the example program by rule – a recursive rule definition - how prolog answers questions – declarative and procedural meaning of programs; Syntax and meaning of Prolog Programs: Data objects – Matching – Declarative and Procedural meaning – Orders of clauses and goals; Relation between Prolog and Logic		CO1
UNIT II	**PROGRAMMING CONSTRUTS**	**9**
List – Operators – Arithmetic; Using Structures: Retrieving structured information from database – Data abstraction – simulating a non-deterministic automation – travel planning – Eight queen problem; Controlling Backtracking: Preventing backtracking – Examples using cut – Negation as failure – problems with cut and negation		CO2
UNIT III	**I/O AND DATA STRUCTURES**	**9**
Input and Output: Communication with files – Processing file of terms – Constructing and Decomposing atoms; Built-in Procedures – Programming Style and Techniques – Operations on Data Structures: Representing and sorting list – Representing sets by binary trees – Insertion and deletion in binary dictionary – Displaying trees – Graphs; Advanced Tree Representations: 2-3 dictionary – AVL-tree		CO3
UNIT IV	**PROLOG IN ARTIFICIAL INTELLIGENCE**	**9**
Basic problem solving strategies – Best Fit – Problem Reduction and AND/OR Graphs – Expert Systems and Knowledge Representation – An Expert System shell – Planning – Language Processing with Grammar Rule		CO4
UNIT V	**MACHINE LEARNING, GAME PLAYING AND META-PROGRAMMING**	**9**
Introduction: The problem of learning concepts – Learning concept by induction – A Program that learns relational descriptions – Learning simple attributional descriptions – Induction of decision trees – Success of learning; Game Playing: Two person – The minimax principle – The alpha-beta algorithm; Meta-Programming: Meta-programs and meta-interpreters – Prolog meta-interpreters – Explanation-based generalization – Object-oriented programming – Pattern directed programming		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison Wesley Publishing Company, Fourth Edition, 2012

REFERENCE BOOKS

2. Bramer M, Logic Programming with Prolog, Springer, 2013
3. Clocksin W, Mellish C S, Programming in Prolog, Springer, 2003

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basics of prolog
CO2	Develop solutions using programming constructs
CO3	Implement data structure concepts using prolog
CO4	Apply prolog in artificial intelligence
CO5	Apply prolog to implement game programming and meta programming

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO2	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO3	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO4	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2
CO5	3	2	2	1	1	-	-	1	-	-	1	2	3	2	2

DS1514	DATA SCIENCE TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of Data Science and import data on Tools
- To perform statistical tests using Data Science Tools.
- To perform specific statistical test using Data Science Tools
- To perform data storage, analysis and modeling using Data Science Tools.
- To learn visualization of data.

UNIT I	INTRODUCTION	9
Introduction to Data Tools – Why Data Science – Where to get data – Importing data into Excel, Apache Open Office, R and Rattle, Rstudio, KNIME.		CO1
UNIT II	**STATISTICAL TESTS USING TOOLS**	**9**
Descriptive Statistics using Excel, Open Office, RStudio / Rattle, KNIME - Cumulative Probability Charts using Excel, Open Office, RStudio / Rattle, KNIME – T – Test using Excel, Open Office, RStudio / Rattle, KNIME. - Correlation using using Excel, Open Office, RStudio / Rattle, KNIME – Regression using Excel, Open Office, RStudio / Rattle, KNIME – Confidence Interval using Excel, Open Office, RStudio / Rattle, KNIME – Random Sampling using using Excel, Open Office, RStudio / Rattle, KNIME.		CO2
UNIT III	**STATISTICAL METHODS FOR SPECIFIC TOOLS**	**9**
Power –R/ RStudio / Rattle. – F-Test – Excel, R/ Rstudio / Rattle. Benford – Rattle, Lift – KNIME, Wordcloud – R/Rstudio, KNIME. Filtering – All Tools.		CO3
UNIT IV	**DATASCIENCE TOOLS FOR DATA STORAGE**	**9**
Apache Hadoop – Microsoft HD insights – Data Science Tools for Exploratory Data Analysis – Informatica PowerCenter – RapidMiner. Data Science Tools for Data Modelling – H2o.ai – Data Robot.		CO4
UNIT V	**DATA VISUALIZATION TOOLS**	**9**
Data Science Tools for Visualization – Tableau – Qlikview. –DataScience Projects using R – Define Problem Statements – Data Cleaning – Data Exploration & Analysis – Data Modeling – Deployment & Optimzation.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Data Science Tools: R • Excel • KNIME • OpenOfficeby Christopher Greco , 2020.

REFERENCE BOOKS

1. Learning tableau 2019: Tools for business intelligence, data prep and visual analytics (3rd edition)
2. QlikView 11 for Developers, Barry Harsen

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the concept of Data Science and import data on Tools
CO2	Perform statistical tests using Data Science Tools.
CO3	Perform specific statistical test using Data Science Tools
CO4	Perform data storage, analysis and modeling using Data Science Tools.
CO5	Learn visualization of data.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	3
CO4	2	2	3	3	2	-	-	-	-	2	2	2	3	3	3
CO5	2	2	2	2	2	-	-	-	-	2	2	2	3	3	3

IT1514	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about first order logics
- To acquire knowledge about reasoning
- To apply object-oriented concepts for various expert systems
- To assess uncertainty using non monotonic logic
- To understand various action and planning strategies for problem solving

UNIT I	INTRODUCTION	9
Knowledge Representation and Reasoning – First order Logic – Syntax- Semantics Pragmatics – Expressing Knowledge – Levels of Representation – Knowledge Acquisition and Sharing – Sharing Ontologies – Language Ontologies –Language Patterns – Tools for Knowledge Acquisition		CO1
UNIT II	**RESOLUTION AND REASONING**	**9**
Proportional Case – Handling Variables and Quantifiers – Dealing with Intractability – Reasoning with Horn Clauses - Procedural Control of Reasoning – Rules in Production– Description Logic - Issues in Engineering		CO2
UNIT III	**REPRESENTATION**	**9**
Object Oriented Representations – Frame Formalism – Structured Descriptions – Meaning and Entailment - Taxonomies and Classification – Inheritance – Networks – Strategies for Defeasible Inheritance – Formal Account of Inheritance Networks		CO3
UNIT IV	**DEFAULTS, UNCERTAINTY AND EXPRESSIVENESS**	**9**
Defaults – Introduction – Closed World Reasoning – Circumscription – Default Logic imitations of Logic – Fuzzy Logic – Non monotonic Logic – Theories and World – Semiotics – Auto epistemic Logic - Vagueness – Uncertainty and Degrees of Belief – Non categorical Reasoning – Objective and Subjective Probability- linguistic fuzzy rule-based classification system - fuzzy cognitive maps- fuzzy for large data		CO4
UNIT V	**ACTIONS AND PLANNING**	**9**
Explanation and Diagnosis – Purpose – Syntax, Semantics of Context – First Order Reasoning Modal Reasoning in Context – Encapsulating Objects in Context – Agents – Actions – Situational Calculus – Frame Problem – Complex Actions – Planning –Strips– Planning as Reasoning – Hierarchical and Conditional Planning		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Michael K. Bergman “A Knowledge Representation Practionary: Guidance from Charles Sanders Peirce.” Springer -2018.
2. Ronald Brachman, Hector Levesque, “Knowledge Representation and Reasoning “, The Morgan Kaufmann Series, First Edition.

REFERENCE BOOKS

1. John F. Sowa, “Knowledge Representation: Logical, Philosophical, and Computational Foundations”, Brokes/Cole, First Edition, 2000.
2. Arthur B. Markman, “Knowledge Representation”, Lawrence Erlbaum Associates,1998.
3. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, Third Edition,

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Formulate problem in first order logic and ontologies
CO2	Improve resolution and reasoning with horn clauses
CO3	Apply object-oriented abstractions for knowledge representation
CO4	Solve problems with uncertainty using fuzzy rules
CO5	Design and develop applications with action and planning

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2

SEMESTER VI
PROFESSIONAL ELECTIVE – II

DS1611	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide a basic foundation towards digital image processing and video processing.
- To learn about image and video enhancement and restoration techniques.
- To provide Compression methods for image analytics applications.
- To Understand Compression methods for video analytics applications
- To learn about feature detection and description

UNIT I	INTRODUCTION TO DIGITAL IMAGE AND VIDEO PROCESSING	9
Digital image representation, Sampling and Quantization, Types of Images, Basic Relations between Pixels - Neighbors, Connectivity, Distance Measures between pixels, Linear and Non Linear Operations, Introduction to Digital Video, Sampled Video, Video Transmission. **Gray-Level Processing:** Image Histogram, Linear and Non-linear point operations on Images, Arithmetic Operations between Images, Geometric Image Operations. **Binary Image Processing:** Image Thresholding, Region labeling, Binary Image Morphology		**CO1**
UNIT II	**IMAGE AND VIDEO ENHANCEMENT AND RESTORATION**	**9**
Spatial domain - Linear and Non-linear Filtering, Morphological filtering, Frequency domain – Homomorphic Filtering, Blotch Detection and Removal - Blotch Detection, Motion Vector Repair and Interpolating Corrupted Intensities, Intensity Flicker Correction - Flicker Parameter Estimation, Brief introduction towards Wavelets, Wavelet based image denoising, Basic methods for image restoration using deconvolution filters		**CO2**
UNIT III	**IMAGE ANALYSIS**	**9**
Image Compression: Huffman coding, Run length coding, LZW coding, Lossless Coding, Wavelets based image compression		**CO3**
UNIT IV	**VIDEO ANALYSIS**	**9**
Video Compression: Basic Concepts and Techniques of Video Coding and the H.264 Standard, MPEG-1 and MPEG-2 Video Standards		**CO4**
UNIT V	**FEATURE DETECTION AND DESCRIPTION**	**9**
Introduction to feature detectors, descriptors, matching and tracking, Basic edge detectors – canny, sobel, prewitt etc., Image Segmentation - Region Based Segmentation – Region Growing and Region Splitting and Merging, Thresholding – Basic global thresholding, optimum global thresholding using Otsu's Method		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOK

1. Alan Bovik, Handbook of Image and Video Processing, Second Edition, Academic Press, 2005.
2. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Edition, Pearson Education, 2008.
3. Richard Szeliski, Computer Vision – Algorithms and Applications, Springer, 2011

REFERENCE BOOKS

1. Anil K Jain, Fundamentals of Digital Image Processing, PHI, 2011.
2. Oge Marques, Practical Image and Video Processing Using MatLab, Wiley, 2011.
3. John W. Woods, Multidimensional Signal, Image, Video Processing and Coding, Academic Press, 2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamental principles of image and video analysis
CO2	Apply different filters for enhancement of image and video
CO3	Investigate different coding techniques.
CO4	Comprehend different compression techniques for video.
CO5	Apply the image and video analysis approaches to solve real world problems.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO2	2	3	2	3	3	-	-	-	-	2	2	2	3	3	3
CO3	1	2	2	3	3	-	-	-	-	2	2	2	3	3	3
CO4	3	2	1	3	3	-	-	-	-	2	2	2	3	3	3
CO5	1	2	3	3	3	-	-	-	-	2	2	2	3	3	3

DS1612	HEALTHCARE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To discuss the role of data analytics in Healthcare and Biomedical data.
- To understand advanced Healthcare data analytics.
- To Identify techniques for data processing
- To understand various optimization and generalization techniques
- To understand various data model

UNIT I	INTRODUCTION	9
Introduction to Healthcare Data Analytics- Healthcare Data Sources and Basic Analytics- Electronic Health Records - Biomedical Image Analysis- Mining of Sensor Data in Healthcare- Biomedical Signal Analysis- Genomic Data Analysis for Personalized Medicine- Natural Language Processing and Data Mining for Clinical Text - Mining the Biomedical Literature.		CO1
UNIT II	**ADVANCED HEALTHCARE DATA ANALYTICS**	**9**
Advanced Data Analytics: Advanced Data Analytics for Healthcare– Review of Clinical. Prediction Models- Temporal Data Mining for Healthcare Data- Visual Analytics for Healthcare- Predictive Models for Integrating Clinical and Genomic Data- Information Retrieval for Healthcare- Privacy-Preserving Data Publishing Methods in Healthcare.		CO2
UNIT III	**DEEP NETWORKS AND DIMENTIONALITY REDUCTION**	**9**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning, Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization.		CO3
UNIT IV	**OPTIMIZATION AND GENERALIZATION**	**9**
Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience.		CO4
UNIT V	**BIGDATA ANALTICS FRAMEWORKS**	**9**
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Chandan K. Reddy and Charu C. Aggarwal," Healthcare Data Analytics", First Edition , Chapman & Hall /CRC Press 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

REFERENCE BOOKS

1. Ross M. Mullner Edward M. Rafalski, "Healthcare Analytics – Foundations and Frontiers" First Edition, T&F/Routledge, 2020.
2. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.
3. El Morr**,** Christo, Ali-Hassan**,** Hossam ," Analytics in Healthcare",springer 2019.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
6. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
7. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

COURSE OUTCOMES
Upon completion of the course, students will be able to

CO1	Describe the role of data analytics in healthcare institutions.
CO2	Describe advanced data analytics methods.
CO3	Apply data processing methods for processing healthcare data.
CO4	Apply Optimization and generalization Techniques.
CO5	Design Data Model that integrates healthcare data.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1	PO2	PO1
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2
CO2	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO4	3	3	3	3	3	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	3	2

DS1613	CLOUD COMPUTING FOR DATA ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of Cloud computing.
- To understand cloud storage
- To discuss serverless concept
- To provide basics of edge computing
- To develop projects pertaining to data science and cloud computing

UNIT I	CLOUD COMPUTING FOUNDATIONS	9
Overview of Cloud Computing – PaaS Continuous Delivery – IaC – Continuous Delivery for Hugo Static Site from Zero; Virtualization & Containerization: CPU – Memory – I/O – Elastic Resources – Kubernetes in the cloud		CO1
UNIT II	**CLOUD STORAGE**	**9**
Cloud Databases: HBase, MongoDB, Cassandra, DynamoDB, Google BigQuery;		CO2
UNIT III	**SERVERLESS**	**9**
FaaS (Function as a Service) - AWS Lambda - GCP Cloud Functions - Azure Functions - AWS Cloud-Native Primitives Overview - AWS Step Machines - AWS SQS - AWS SNS - AWS Cognito - AWS API Gateway		CO3
UNIT IV	**EDGE COMPUTING**	**9**
IoT Overview - AWS Greengrass - Raspberry Pi - Edge Machine Learning Solutions Overview - Google AutoML - Tensorflow lite - Intel Movidius - Apple X12		CO4
UNIT V	**DATA SCIENCE CASE STUDIES AND PROJECTS**	**9**
Case Study: Datascience meets intermittent fasting - Coronavirus Epidemic; Applied Computer Vision Overview; Project: AWS DeepLense Edge Computer Vision - Rasberry Pi - Intel Movidius Edge Computer Vision - Serverless Data Engineering Pipelines - Operationalizing Containerized Machine Learning Models - Continuous Delivery of GCP PaaS		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Noah Gift, Cloud Computing for Data Science, Pragmatic AI Labs, 2020

REFERENCE BOOKS

1. Francesco Diaz and Roberto Freato, Cloud Data Design, Orchestration, and Management Using Microsoft Azure, Apress

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the core concepts of the cloud computing paradigm.
CO2	Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems.
CO3	Apply AWS for problem solving
CO4	Comprehend edge computing
CO5	Develop data science models and apply them to solve problems on the cloud.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	-	2	2	-	2	2	2	2	3	2
CO2	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO3	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO4	3	3	3	3	3	-	2	2	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	2	2	-	2	2	2	2	3	2

DS1614	COMPUTATIONAL THINKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand different optimization problems.
- To learn about random and stochastic process
- To learn about simulation condition for optimization problems
- To provide students with an understanding of the role statistics.
- To use algorithms for classification and clustering problems.

UNIT I	OPTIMIZATION PROBLEMS	9
Knapsack problem: Greedy Algorithms – 0/1 Knapsack Problem; Graph Optimization Problem: Some classic Graph theoretical problems – Shortest Path: Depth first and Breadth first search; Dynamic Programming: Fibonacci sequences – 0/1 knapsack problem – divide and conquer		CO1
UNIT II	**RANDOM WALKS AND STOCHASTIC PROGRAMS**	**9**
Random walks – The Drunkard's walk – Biased Random walks – Treacherous Fields; Stochastic Programs – Calculating simple probabilities – Inferential Statistics – Distributions – Hashing and Collisions		CO2
UNIT III	**SIMULATION AND SAMPLING**	**9**
Monte Carlo Simulation: Pascal's Problem – Pass or Don't Pass? – Using Table Lookup to Improve Performance – Finding π; Sampling and Confidence intervals: Sampling the Boston Marathon – The Central Limit Theorem – Standard Error of the Mean; Understanding the experimental data: The behavior of springs – The behavior of Projectiles		CO3
UNIT IV	**RANDOMIZED TRIALS AND STATISTICS**	**9**
Checking significance – Beware of P-values – One tail and one sample tests – Multiple Hypothesis; Conditional Probability and Bayesian statistics: Conditional Probabilities – Bayes Theorem – Bayesian Updating; Lies, Demned Lies and statistics: Garbage In and Garbage Out – Sampling Bias – Context Matters		CO4
UNIT V	**CLUSTERING AND CLASSIFICATION**	**9**
A Quick Look at Machine Learning: Feature vectors – Distance Metrics; Clustering: Class cluster – k-means clustering – A Contrived Example – A Less Contrived Example; Classification Methods: Evaluating Classifiers – Predicting the Gender of Runner – k-nearest neighbors – Regression based classifiers – Surviving the Titanic		CO5

TOTAL : 45 PERIODS

TEXT BOOK

1. John V Guttag, Introduction to Computation and Programming using python: with application to understanding data, MIT Press, Second Edition

REFERENCE BOOKS

1. Karl Beecher, Computational Thinking: A beginner's guide to problem solving and programming, BCS, The Charted Institute for IT

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand of the role computation in solving problems.
CO2	Apply stochastic models for problem solving
CO3	Apply probability theory for simulation
CO4	Apply statistical models for computation.
CO5	Develop projects pertaining to classification and clustering.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	1	-	-	1	-	-	1	1	3	3	2
CO2	3	3	2	1	1	-	-	1	-	-	1	1	3	3	2
CO3	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2
CO4	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2
CO5	3	3	2	1	1	-	-	1	-	-	1	1	3	2	2

DS1615	ETHICS IN DATA SCIENCE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To apply ethical frameworks, guidelines, and codes to all phases of the analytics process.
- To describe the historical efforts in developing ethical practices in research.
- To identify how current standards provide a necessary but insufficient foundation for applying ethics in data science and analytics.
- To reflect on and acknowledge the centrality of the human in the analytics process.
- To distinguish between what an organization would like to do, what can be done technically, what can be done legally, and what should be done from an ethical perspective when performing and managing analytics projects.

UNIT I	INTRODUCTION	9
Ethics Review; Business Ethics; Elements of Big Data Ethics: Cambridge Analytica (example), Ethical Guidelines and Codes.		CO1
UNIT II	**ARTIFICIAL INTELLIGENCE**	**9**
Algorithmic Bias, Analyzing Behavioral Big Data: Methodological, Practical, Ethical, & Moral Issues, AI's White Guy Problem Data Mining to Recruit Sick People License Plate Readers.		CO2
UNIT III	**RESEARCH ETHICS**	**9**
Necessary but Not Sufficient, Legal Frameworks; Regional (US, Europe, Asia) Differences, The 4R's: Reuse, Repurposing, (Re)Combining, Reanalysis.		CO3
UNIT IV	**ETHICAL ISSUES**	**9**
Ethical Issues in Sports and Healthcare; Wearable Device Data; Ethical Issues in HR & Talent Analytics; Analytics for Social Good.		CO4
UNIT V	**CASE STUDY**	**9**
Facebook Mood Manipulation Facebook Faces New World Opioid Crisis; Disney / Staples Center Monitoring Is Alexa So Dangerous? Smart Toys; Reducing Costs of Employee Churn Boss Using Slack to Spy on You; Combatting Fake News Can AI Wipe Unconscious Bias? Child Abuse Prevention.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Davis, Kord, Ethics of Big Data, O'Reilly,

REFERENCE BOOKS

1. Loukides, Mike, Hilary Mason, and DJ Patil. 2018. Ethics and Data Science. Sebastopol, CA: O'Reilly Media.
2. Global Engineering Ethics (2017), by Heinz Luegenbiehl and Rockwell Clancy, Elsevier Press

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply ethical frameworks, guidelines, and codes to all phases of the analytics process.
CO2	Describe the historical efforts in developing ethical practices in research.
CO3	Identify how current standards provide a necessary but insufficient foundation for applying ethics in data science and analytics.
CO4	Reflect on and acknowledge the centrality of the human in the analytics process.
CO5	Distinguish between what an organization would like to do, what can be done technically, what can be done legally, and what should be done from an ethical perspective when performing and managing analytics projects.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO2	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO3	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO4	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2
CO5	3	3	2	3	2	3	3	2	2	2	2	2	2	2	2

SEMESTER VII
PROFESSIONAL ELECTIVE – III

DS1711	DATA AND INFORMATION SECURITY	L	T	P	C
		3	1	0	3

OBJECTIVES

- To understand the data security fundamentals as well as Cryptography Theories, Algorithms and Systems.
- To apply the various Authentication Schemes to simulate different applications.
- To understand the various security standards, threats and vulnerabilities.
- To understand fundamentals of information security in various fields
- To understand various security services and their practices.

UNIT I	DATA SECURITY FUNDAMENTALS	9
Security trends – Security attacks, services and mechanisms – OSI security architecture - Types of Classical Encryption Techniques - Block Ciphers and stream ciphers - DES – AES - Public key cryptosystems - RSA-Diffie Hellman Key Exchange - Elliptic curve Cryptography.		CO1
UNIT II	**MESSAGE AUTHENTICATION AND INTEGRITY**	**9**
Authentication requirement – Authentication function – MAC – Hash function – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos, X.509-key distribution.		CO2
UNIT III	**SYSTEM SECURITY**	**9**
Electronic Mail security – PGP, S/MIME – IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.		CO3
UNIT IV	**INFORMATION SECURITY**	**9**
Introduction-What is information security-Identification and Authentication-Authorization and Access Control-Auditing and Accountability-Operation Security.		CO4
UNIT V	**SECURITY PRACTICES**	**9**
Human Element Security -Physical Security-Mobile, Embedded and IoT Security-Application Security-Assessing security.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. William Stallings, Cryptography and Network Security Principles and Practice, 6th Edition,Pearson Education,2014.
2. Jason Andress, Foundations of Information security (A Straightforward Introduction) no starch press,San Francisco,William Pollock,2019.

REFERENCE BOOKS

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and NetworkSecurity, Wiley India Pvt.Ltd, 2011.
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2, 2012.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the fundamentals of data security and apply the different cryptographic operations of symmetric and public cryptographic algorithms.
CO2	Apply the various Authentication schemes to simulate different applications.
CO3	Understand various System security standards, threats and vulnerabilities.
CO4	Understand fundamentals of information security in various fields.
CO5	Understand various security services and their security practices.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	2	2

DS1712	EVOLUTIONARY COMPUTATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the relations between the most important evolutionary algorithms presented in the course, new algorithms to be found in the literature now or in the future, and other search and optimisation techniques.
- Understand the implementation issues of evolutionary algorithms.
- Determine the appropriate parameter settings to make different evolutionary algorithms work well.
- Formulate a problem as an evolutionary computation search/optimization by specifying representations, selection and variation operators.
- Design new evolutionary operators, representations and fitness functions for specific practical and scientific applications.

UNIT I	INTRODUCTION	9
Optimization – Robust Adaptation – Machine Intelligence – Applications of Evolutionary Computation: Applications in Planning – Design – Simulation and Identification – Control – Classification; Principles of Evolutionary Processes - Principles of Genetics: Fundamental concepts in genetics – the gene – options for change – population thinking; Evolutionary Programming – Genetic Algorithms – Evolution strategies		**CO1**
UNIT II	**EVOLUTIONARY ALGORITUMS AND TUEIR STANDARDINSTANCES**	**9**
General outline of evolutionary algorithms – Genetic algorithms: basics and some variations – mutations and crossover – Representation – Parallel genetic algorithms; Evolution strategies: the archetype of evolution strategies – contemporary evolution strategies – nested evolution strategies; Evolutionary Programming - Derivative methods in genetic programming - Learning classifier systems - Hybrid methods		**CO2**
UNIT III	**REPRESENTATION**	**9**
Introduction to representations: Solutions and representations - Irnportant representations - Combined representations; Binary strings - Real-valued vectors; Permutations - Mapping integers to permutations - The mapping function - Matrix representations - Alternative representations - Ordering schemata and other metrics - Operator descriptions and local search; Finite-state representations - Parse trees - Other representations: Mixed-integer structures – Introns - Diploid representations		**CO3**
UNIT IV	**SELECTION**	**9**
Introduction to selection: Working mechanisms – Pseudocode - Theory of selective pressure; Proportional selection and sampling algorithms: Fitness functions - Selection probabilities – Sampling – Theory; Tournament selection - Rank-based selection - Boltzmann selection - Other selection methods - Generation gap methods - comparison of selection mechanisms - Interactive evolution		**CO4**
UNIT V	**SEARCH OPERATORS**	**9**
Mutation operators: Binary strings - Real-valued vectors - Permutations - Finite-state machines - Parse trees - Other representations; Recombination: Binary strings - Real-valued vectors - Permutations - Finite-state machines - Crossover: parse trees - Other representations - Multiparent recombination; Other operators: The Baldwin effect - Knowledge-augmented operators - Gene duplication and deletion		**CO5**
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Thomas Bäck, David B Fogel and Zbigniew Michalewicz, Evolutionary Computation 1 - Basic Algorithms and Operators, Taylor & Francis

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Review the evolutionary computation techniques
CO2	Investigate evolutionary algorithms
CO3	Apply representation concept for evolutionary computation problems
CO4	Analyze selection operation concept for evolutionary computation problems
CO5	Formulate a problem as an evolutionary computation search/optimization by specifying representations, selection and variation operators.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO2	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO3	3	3	3	3	2	-	2	2	-	2	2	2	3	3	2
CO4	3	3	3	3	2	-	2	2	-	2	2	2	3	2	2
CO5	3	3	3	3	2	-	2	2	-	2	2	2	3	2	2

DS1713	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic pattern recognition concepts.
- Apply the mathematical foundations for recognition of patterns.
- Identify the pattern Recognition models.
- To study various pattern matching techniques.
- Apply the non-parametric techniques and clustering techniques in pattern Recognition in real time applications.

UNIT I	INTRODUCTION	9
Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis.		CO1
UNIT II	**STATISTICAL PATTERN RECOGNITION**	**9**
Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.		CO2
UNIT III	**MODELS**	**9**
Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models.		CO3
UNIT IV	**NON-PARAMETRIC TECHNIQUES**	**9**
Nonparametric Techniques: Density Estimation – Parzen Windows – K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification.		CO4
UNIT V	**CLUSTERING TECHNIQUES**	**9**
Unsupervised Learning and Clustering: Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation.		CO5
		TOTAL: 45 PERIODS

REFERENCE BOOKS

1. Richard O. Duda, Peter E. Hart and David G. Stork, “Pattern Classification”, Second Edition, John Wiley, 2006.
2. Bishop, Christopher M., “Pattern Recognition and Machine Learning”, First Edition, Springer, 2009.
3. S. Theodoridis, K. Koutroumbas, “Pattern Recognition”, Fourth Edition, Academic Press, 2009.
4. Keinosuke Fukunaga, “Introduction to Statistical Pattern Recognition”, Second Edition, Academic Press, 2003.
5. Sergios Thedoridis, Konstantinos Koutroumbas, “Pattern Recognition”, Fourth Edition, Academic Press, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To understand the basic pattern recognition concepts.
CO2	Apply the mathematical foundations for recognition of patterns.
CO3	Identify the pattern Recognition models.
CO4	To study various pattern matching techniques.
CO5	Apply various clustering algorithms

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

DS1714	WEB ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Be introduced to Web Analytics.
- Be aware of some Web-based Analytics and software products.
- Be aware of the different analytics tools.
- Learn Affiliate, Internet, and Referral Marketing.
- Understand advertising using analytics.

UNIT I	INTRODUCTION	9
Understanding web analytics – The foundations of Web analytics: Techniques and Technologies – Present and Future of Web analytics.		CO1
UNIT II	**DATA COLLECTION**	**9**
Importance and Options –Web server log files: Click stream data – User submitted information – Web server performance data – Page tags –First and third party tracking		CO2
UNIT III	**WEB ANALYTICS STRATEGY**	**9**
Key performance indicators – Web analytics process – Heuristics evaluations – Site visits – Surveys – Measuring reach – Measuring acquisition – Measuring conversion – Measuring retention – Security and privacy implications of Web analytics		CO3
UNIT IV	**WEB ANALYTICS TOOLS**	**9**
Content organization tools – Process measurement tools – Visitor segmentation tools – Campaign analysis tools – Commerce measurement tools – Google analytics – Omniture – Web trends – Yahoo! Web analytics		CO4
UNIT V	**GOOGLE ANALYTICS**	**9**
Key features and capabilities – Quantitative and qualitative data - Working of Google analytics – Privacy - Tracking visitor clicks, Outbound links and Non HTML files		CO5

TOTAL: 45 PERIODS

TEXT BOOKS

1. Bernard J. Jansen, Understanding User-Web Interactions via Web analytics, Morgan and Claypool, 2009.
2. Justin Cutroni, Google Analytics, O"Reilly, 2015.

REFERENCE BOOKS

1. Avinash Kaushik, Web Analytics2.0, John Wiley and Sons, 2010.
2. Brian Clifton, Advanced web metrics with Google analytics, John Wiley and Sons, 2012.
3. Jerri L. Ledford, Joe Teixeira and Mary E. Tyler, Google Analytics, John Wiley and Sons, 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Explain the foundations of Web analytics
CO2	Compare and contrast the clickstream data collection techniques, their impact on metrics, and their inherent limitations
CO3	Apply web analytics techniques to effectively use the resulting insights to support website design decisions, campaign optimization, search analytics, etc
CO4	Understand the basics of software tools, techniques, and reports that are relevant to web analytics apply them to solve problems
CO5	Analyze and interpret web channel data and understand the difficulties and issues involved in it

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO2	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO3	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO4	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3
CO5	3	3	3	3	2	3	2	-	-	3	2	2	3	3	3

MG1001	PRINCIPLE OF MANAGEMENT	L	T	P	C
	Common to CSE & AI-DS	3	0	0	3

OBJECTIVES

- To enable the students to study the evolution of Management
- To study the functions and principles of management
- To learn the application of the principles in an organization

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9
Definition of Management – Science or Art – Manager vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.		CO1
UNIT II	**PLANNING**	**9**
Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.		CO2
UNIT III	**ORGANISING**	**9**
Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority –77 centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management		CO3
UNIT IV	**DIRECTING**	**9**
Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.		CO4
UNIT V	**CONTROLLING**	**9**
System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

REFERENCE BOOKS

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Familiar with Management and Organizations task
CO2	Decision Making and Planning
CO3	Know about HRM, Performance Management, HR planning.
CO4	Communication and Motivational Theories
CO5	Familiar with controlling of process and reporting

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO2	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO3	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO4	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2
CO5	3	3	3	-	-	-	-	-	-	-	3	-	2	2	2

SEMESTER VII
PROFESSIONAL ELECTIVE – IV

DS1721	STOCHASTIC PROCESS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Study of the basic concepts of the theory of stochastic processes;
- Introduce of the most important types of stochastic processes;
- Study simplest and important classes of stochastic processes namely Poisson processes, Branching processes, Renewal Processes and Markov chains.
- Learn the applications of Stationary Processes

UNIT I	INTRODUCTION TO STOCHASTIC PROCESSES	9
Classification of Stochastic Processes, Markov Processes – Markov Chain - Countable State Markov Chain. Transition Probabilities, Transition Probability Matrix. Chapman - Kolmogorov's Equations, Calculation of n - step Transition Probability and its limit		CO1
UNIT II	**POISSON PROCESS**	**9**
Classification of States, Recurrent and Transient States - Transient Markov Chain, Random Walk and Gambler's Ruin Problem. Continuous Time Markov Process:, Poisson Processes, Birth and Death Processes, Kolmogorov's Differential Equations, Applications		CO2
UNIT III	**BRANCHING PROCESS**	**9**
Branching Processes – Galton – Watson Branching Process - Properties of Generating Functions – Extinction Probabilities – Distribution of Total Number of Progeny. Concept of Weiner Process		CO3
UNIT IV	**RENEWAL PROCESS**	**9**
Renewal Processes – Renewal Process in Discrete and Continuous Time – Renewal Interval – Renewal Function and Renewal Density – Renewal Equation – Renewal theorems: Elementary Renewal Theorem. Probability Generating Function of Renewal Processes		CO4
UNIT V	**STATIONARY PROCESS**	**9**
Stationary Processes: Discrete Parameter Stochastic Process – Application to Time Series. Auto-covariance and Auto-correlation functions and their properties. Moving Average, Autoregressive, Autoregressive Moving Average, Autoregressive Integrated Moving Average Processes. Basic ideas of residual analysis, diagnostic checking, forecasting		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. R.G Gallager, Stochastic Processes, Cambridge University Press, 2013.
2. S.M Ross, Stochastic Processes, Wiley India Pvt. Ltd, 2008

REFERENCE BOOKS

1. Stochastic Processes from Applications to Theory, P.D Moral and S. Penev, CRC Press, 2016
2. B..C. Liliana, A Viswanathan, S. Dharmaraja, Introduction to Probability and Stochastic Processes with Applications, Wiley Pvt. Ltd, 2012.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Classify a stochastic process, understand markov processes and handle discrete state markov chain properties with transition probability matrix.
CO2	Understand the classification of states of markov chain, continuous markov chain and Poisson processes
CO3	Explore the Branching processes
CO4	Explore the Renewal processes
CO5	Understand the Stationary Processes and apply the same for some real life applications.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO2	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO3	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO4	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO5	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2

DS1722	SOFTWARE TESTING USING AUTOMATED TOOLS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop and validate a test plan
- To select and prepare test cases
- To identify the need for testing
- To prepare testing policies and standards
- To use testing aids and tools

UNIT I	INTRODUCTION	9
Testing as an Engineering Activity – Testing as a Process – testing axioms - Basic Definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – cost of defects - Defect Classes – The Defect Repository and Test Design – Defect Examples – Developer/Tester Support for Developing a Defect Repository – Defect Prevention Strategies – Software Testing Life cycle – V model		CO1

UNIT II	TEST CASE DESIGN	9
Test Case Design Strategies – Using Black Box Approach to Test Case Design - Random Testing – Requirements based testing –Boundary Value Analysis – Decision tables - Equivalence Cl ass Partitioning - State-based testing – Cause-effect graphing – Error guessing - Compatibility testing – User documentation testing –Domain testing Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing - Coverage and Control Flow Graphs – Covering Code Logic – Paths – Their Role in White–box Based Test Design –code complexity testing – Evaluating Test Adequacy Criteria		CO2

UNIT III	LEVELS OF TESTING	9
The Need for Levels of Testing – Unit Test – Unit Test Planning –Designing the Unit Tests - The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing - Regression Testing – Internationalization testing – Ad-hoc testing -Alpha , Beta Tests – testing OO systems – Usability and Accessibility testing – Configuration testing - Compatibility testing – Testing the documentation –Website testing –Static testing –reviews - walkthrough		CO3

UNIT IV	TEST MANAGEMENT	9
People and organizational issues in testing – organization structures for testing teams – testing services - Test Planning – Test Plan Components – Test Pl and Attachments – Locating Test Items – test. management – test process - Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group – Designing test cases using MS-Excel –Test Data management		CO4

UNIT V	TEST AUTOMATION	9
Software test automation – skills needed for automation – scope of automation – design and architecture for automation –requirements for a test tool – challenges in automation - Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing, understanding Testing framework with Selenium Web driver for automation testing		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles and Practices”, Pearson education, 2006.
2. Ilene Burnstein, “Practical Software Testing”, Springer International Edition, 2012

REFERENCE BOOKS

1. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson,2007
2. Renu Rajani, Pradeep Oak, “Software Testing –Effective Methods, Tools and Techniques”,TMH 2004.
3. Rex Black (2001), Managing the Testing Process (2nd edition), John Wiley & Son
4. Dorothy Graham, Erik van Veenendaal, Isabel Evans, Foundations of software testing, Rex Black
5. Elfriede Dustin, Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the types of errors and fault models
CO2	Create test cases from requirements
CO3	Analyze use o various testing tools
CO4	Evaluate adequacy assessment using: control flow, data flow, and program mutations
CO5	Apply software testing techniques in commercial environments

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO2	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO3	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO4	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1
CO5	1	2	1	1	1	-	-	1	-	1	1	1	2	2	1

DS1723	SOCIAL NETWORK ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To detect communities in social networks.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

UNIT I	INTRODUCTION	9
Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Statistical properties of social Networks-Definitions-Data Descriptions-Static properties- Dynamic properties-Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.		CO1
UNIT II	**MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION**	**9**
Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.		CO2
UNIT III	**EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS**	**9**
Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.		CO3
UNIT IV	**PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES**	**9**
Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.		CO4
UNIT V	**VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS**	**9**
Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks-Random Walk based Proximity Measures -Clustering with random walk based measures-Algorithms for Computing Personalized PageRank and Sim Rank –Application-Computer Vision - Text Analysis -Collaborative Filtering - Combating Web Spam.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Peter Mika, “Social Networks and the Semantic Web”, First Edition, Springer 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, 1st Edition, Springer, 2010.
3. Charu C. Aggarwal, “Social Network Data Analytics”, First Edition, Springer 2011.

REFERENCE BOOKS

1. David Camacho,Angel, Gema Bello and Antonio,”The Four Dimensions of Social Network Analysis: An Overview of Research Methods, Applications, and Software Tools” Feb 2020.
2. Guandong Xu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, First Edition, Springer, 2011.
3. John G. Breslin, Alexander Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop semantic web related applications.
CO2	Represent knowledge using ontology.
CO3	Detect communities in social networks.
CO4	Predict human behavior in social web and related communities.
CO5	Visualize social networks.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	2	3	2
CO4	2	2	3	3	2	-	-	-	-	2	2	2	2	3	2
CO5	2	2	2	2	2	-	-	-	-	2	2	2	2	2	2

DS1724	MULTIVARIATE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To give mathematical and statistical background to handle the analysis involving multivariable.
- To explore the joint performance of the variables as well as to determine the effect of each variable in the presence of the others.
- To intelligently analyze data using appropriate multivariate methods
- Likelihood ratio tests, MANOVA models, Discriminate procedures and Factor analysis are included with the objective to handle and understand the concept of exploratory and confirmatory data analysis

UNIT I	INTRODUCTION	9
Basic concepts on multivariate variable. Multivariate normal distribution, Marginal and conditional distribution, Concept of random vector: Its expectation and Variance-Covariance matrix. Marginal and joint distributions. Conditional distributions and Independence of random vectors. Multinomial distribution. Sample mean vector and its distribution		CO1
UNIT II	**DISTRIBUTION**	**9**
Sample mean vector and its distribution. Likelihood ratio tests: Tests of hypotheses about the mean vectors and covariance matrices for multivariate normal populations. Independence of sub vectors and sphericity test		CO2
UNIT III	**MULTIVARIATE ANALYSIS**	**9**
Multivariate analysis of variance (MANOVA) of one and two- way classified data. Multivariate analysis of covariance. Wishart distribution, Hotelling's T2 and Mahalanobis' D2 statistics, Null distribution of Hotelling's T2. Rao's U statistics and its distribution		CO3
UNIT IV	**CLASSIFICATION AND DISCRIMINANT PROCEDURES**	**9**
Bayes, minimax, and Fisher's criteria for discrimination between two multivariate normal populations. Sample discriminant function. Tests associated with discriminant functions. Probabilities of misclassification and their estimation. Discrimination for several multivariate normal populations		CO4
UNIT V	**PRINCIPAL COMPONENT and FACTOR ANALYSIS**	**9**
Principal components, sample principal components asymptotic properties. Canonical variables and canonical correlations: definition, estimation, computations. Test for significance of canonical correlations. Factor analysis: Orthogonal factor model, factor loadings, estimation of factor loadings, factor scores. Applications		CO5
		TOTAL: 45 PERIODS

TEXT BOOKS

1. Anderson, T.W. 2009. An Introduction to Multivariate Statistical Analysis, 3rd Edition, John Wiley.
2. Everitt B, Hothorn T, 2011. An Introduction to Applied Multivariate Analysis with R, Springer.
3. Barry J. Babin, Hair, Rolph E Anderson, and William C. Blac, 2013, Multivariate Data Analysis, Pearson New International Edition

REFERENCE BOOKS

1. Giri, N.C. 1977. Multivariate Statistical Inference. Academic Press.
2. Chatfield, C. and Collins, A.J. 1982. Introduction to Multivariate analysis. Prentice Hall
3. Srivastava, M.S. and Khatri, C.G. 1979. An Introduction to Multivariate Statistics. North Holland

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Describe properties of multivariate distributions such as multivariate normal.
CO2	Do Likelihood ratio tests on mean vectors and covariance matrices , understand and interpret the computations of the critical values associated with these tests
CO3	Do Testing of various hypotheses for multivariate analysis of variance (MANOVA) models
CO4	Discriminate between groups and classify new observations using various discriminate procedures
CO5	Use principal component analysis effectively for data exploration and data dimension reduction. Use factor analysis effectively for exploratory and confirmatory data analysis.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO2	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO3	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO4	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2
CO5	3	3	2	1	2	-	-	1	-	-	2	2	3	2	2

MG1725	ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn about how to establish a company
- To know how to find financial resources
- To learn the survival skills in accounting and financial management
- To know the fundamentals of finance and marketing
- To know about intellectual properties and prepare patents

UNIT I	HOW TO ESTABLISH THE COMPANY	9
The Founder and Team –Legal Procedure –Executive Summary –Management and Organization – Product/Service – Business Plan –Marketing Plan –Operating and Control Systems –Micro and Mac ro Environmental Fa ctors – Growth Plan –Financial Plan		CO1
UNIT II	**HOW TO FIND FINANCIAL RESOURCES**	**9**
Debt and Equity: Stock or Loan –Partnership –Venture Capital/Angel Money –Bank Loans – Research Funds: Small Business Innovation Research Programs –Successful Proposal Writing –Successful Proposal Presentation		CO2
UNIT III	**SURVIVAL SKILLS IN ACCOUNTING AND FINANCIAL MANAGEMENT**	**9**
Accounting Management –Sales and Payroll: Daily Accounting –Financial Statements – Demand, Supply, and Market Equilibrium –Break-even Analysis –Tax reduction considerations - Cash Flow Analysis		CO3
UNIT IV	**FUNDAMENTALS OF FINANCE AND MARKETING**	**9**
Key Financial Ratios –Financial forecasting –Time Value of Money –Short-term Financing – Investment Decisions – Marketing Research: The Five P's of Marketing Research – Target Marketing – Marketing Research Examples, Portfolio Model, Marketing Mix Four P's: Product, Price, Place, Promotion		CO4
UNIT V	**INTELLECTUAL PROPERTIES**	**9**
Intellectual Properties –Why is Intellectual Properties important –Patent preparation –Patent infringement (Law suits)		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kenji Uchino, "Entrepreneurship for Engineers", CRC Press, 2010 Second book

REFERENCE BOOKS

1. Paul Swamidass, "Engineering Entrepreneurship from Idea to Business Plan", Cambridge University Press, 2016.
2. Hisrich, "Entrepreneurship", Tata McGraw Hill, 9th Edition, 2014

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Know how to establish a company
CO2	Understand how to find financial resources
CO3	Determine the survival skills in accounting and financial management
CO4	Understand the fundamentals of finance and marketing
CO5	Know about intellectual properties and patent preparation

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO2	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO3	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO4	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1
CO5	-	-	-	1	-	1	1	1	-	1	1	1	2	2	1

SEMESTER VIII
PROFESSIONAL ELECTIVE – V

DS1811	DATA MINING AND INFORMATION SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand data pre-processing and data visualization techniques.
- To study algorithms in pattern mining.
- To understand and apply various classification and clustering techniques using tools.
- To study advanced concepts in Information security and Risk management.
- To understand and apply security technologies.

UNIT I	DATA MINING – INTRODUCTION	9
Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques– Issues – applications- Data Objects and attribute types, Statistical description of data, Data Visualization, Data similarity and dissimilarity measures, Data Preprocessing: Cleaning, Integration, Reduction, Transformation and discretization.		CO1
UNIT II	**PATTERN MINING**	**9**
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods-Frequent Itemset Mining Methods-Advanced Pattern Mining: Pattern Mining in Multilevel, Multidimensional Space-Constraint-Based Frequent Pattern Mining-Mining High-Dimensional Data and Colossal Patterns-Mining Compressed or Approximate Patterns-Pattern Exploration and Application		CO2
UNIT III	**CLASSIFICATION AND CLUSTERING**	**9**
Basic concepts-Decision Tree Induction - Bayes Classification Methods– Rule Based Classification – Model Evaluation and Selection-Techniques to Improve Classification Accuracy-Advanced methods: Bayesian Belief Networks-Classification by Back Propagation – Support Vector machines –– Lazy Learners - Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering Graph and Network Data-Clustering with constraints.		CO3
UNIT IV	**INFORMATION SECURITY: ADVANCED CONCEPTS**	**9**
The need for security-legal, Ethical and professional issues-Risk management: Risk Identification, Risk Assessment, Risk control strategies-selecting a risk control strategy.		CO4
UNIT V	**SECURITY TECHNOLOGY AND IMPLEMENTATION**	**9**
Intrusion detection and prevention systems-Honeypots and honeynets-Scanning and analysis tools-Biometric access control-Information security project management-Technical aspects of implementation-information security maintenance.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition,Elsevier, 2012.
2. Michael e Whitman, Herbert J Mattord,“Principles of Information security”,Fourth Edition,2011

REFERENCE BOOKS

1. Charu C. Aggarwal ,Jiawei Han , “Frequent Pattern Mining”, Springer,2014.
2. Malcolm W. Harkins, “Managing Risk and Information Security”, 2016.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Apply suitable pre-processing and visualization techniques for data analysis
CO2	Apply frequent pattern and association rule mining techniques for data analysis
CO3	Apply appropriate classification and clustering techniques for data analysis
CO4	Apply concepts in Information security and Risk management.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO2	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO3	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO4	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2
CO5	3	3	3	3	3	2	-	-	-	1	3	2	2	3	2

DS1812	SPEECH PROCESSING AND SYNTHESIS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing

UNIT I	FUNDAMENTALS OF SPEECH PROCESSING	9
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		CO1
UNIT II	**SPEECH SIGNAL REPRESENTATIONS AND CODING**	**9**
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.		CO2
UNIT III	**SPEECH RECOGNITION**	**9**
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		CO3
UNIT IV	**TEXT ANALYSIS**	**9**
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		CO4
UNIT V	**SPEECH SYNTHESIS**	**9**
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. James Whitaker, John Liu, and Uday Kamath, Deep learning for NLP and Speech Recognition,Springer,2019.
2. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
3. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)‖, Marcel Dekker, 2000.
5. Thomas F.Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education, 2002.
6. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – A guide to Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
CO2	Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
CO3	Justify the use of formant and concatenative approaches to speech synthesis
CO4	Identify the apt approach of speech synthesis depending on the language to be processed
CO5	Determine the various encoding techniques for representing speech.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

DS1813	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students should be able to understand.
- The difference between threat, risk, attack and vulnerability.
- How threats materialize into attacks.
- Where to find information about threats, vulnerabilities and attacks.
- Typical threats, attacks and exploits and the motivations behind them.

UNIT I	INTRODUCTION TO CYBER SECURITY	9
Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls - Authentication - Access Control and Cryptography - Web—User Side - Browser Attacks - Web Attacks Targeting Users - Obtaining User or Website Data - Email Attacks		CO1
UNIT II	**SECURITY IN OPERATING SYSTEM & NETWORKS**	**9**
Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.		CO2
UNIT III	**DEFENCES: SECURITY COUNTERMEASURES**	**9**
Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.		CO3
UNIT IV	**PRIVACY IN CYBERSPACE**	**9**
Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies - Where the Field Is Headed.		CO4
UNIT V	**MANAGEMENT AND INCIDENTS**	**9**
Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
3. Martti Lehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
4. Nelson Phillips and Enfinger Steuart, ―Computer Forensics and Investigations‖, Cengage Learning, New Delhi, 2009.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Describe and understand the basics of the ethical hacking
CO2	Perform the foot printing and scanning - Demonstrate the techniques for system hacking
CO3	Characterize the malware and their attacks and detect and prevent them
CO4	Determine the signature of different attacks and prevent them
CO5	Detect and prevent the security attacks in different environments

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO2	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO3	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO4	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2
CO5	3	3	3	-	2	-	-	1	2	2	-	2	3	2	2

DS1814	PREDICTIVE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, logistic regression, support vector machines and , K-nearest – Neighbour classifiers.
- To know the use of the binary classifier and numeric predictor nodes to automate model selection.
- To advice on when and how to use each model.
- Also learn how to combine two or more models to improve prediction
- To learn about supervised and unsupervised learning

UNIT I	LINEAR METHODS FOR REGRESSION AND CLASSIFICATION	9
Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection, Ridge regression, Lasso regression, Linear Discriminant Analysis, Logistic regression, Perceptron learning algorithm.		CO1
UNIT II	**MODEL ASSESMENT AND SELECTION**	**9**
Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate, Esimate of In-sample prediction error, Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, conditional or expected test error.		CO2
UNIT III	**ADDITIVE MODELS, TREES AND BOOSTING**	**9**
Generalized additive models, Regression and classification trees, Boosting methods-exponential loss and AdaBoost, Numerical Optimization via gradient boosting, Examples (Spam data, California housing, NewZealand fish, Demographic data)		CO3
UNIT IV	**NEURAL NETWORKS(NN) , SUPPORT VECTOR MACHINES(SVM), AND K-NEAREST NEIGHBOR**	**9**
Fitting neural networks, Back propagation, Issues in training NN, SVM for classification, Reproducing Kernels, SVM for regression, K-nearest –Neighbour classifiers(Image Scene Classification)		CO4
UNIT V	**UNSUPERVISED LEARNING AND RANDOM FORESTS**	**9**
Association rules, Cluster analysis, Principal Components, Random forests and analysis.		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. G.James,D.Witten,T.Hastie,R.Tibshirani-An introduction to statistical learning with applications in R,Springer,2013.
2. E.Alpaydin, Introduction to Machine Learning, Prentice Hall Of India,2010.
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman , The Elements of Statistical Learning-Data Mining, Inference, and Prediction ,Second Edition , Springer Verlag, 2009.
4. C.M.Bishop –Pattern Recognition and Machine Learning,Springer,2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop simple applications regression and classifications.
CO2	Design and implement model assessment and selection.
CO3	Develop and implement applications using additive models.
CO4	Develop applications using neural network and support vector machine.
CO5	Design applications using cluster and random forest analysis.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO2	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO3	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO4	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3
CO5	3	3	3	3	3	3	-	-	-	2	2	2	3	3	3

DS1815	STATISTICAL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand probability distributions, random number generation and density estimations to analysis the different kind of data
- To learn Monte Carlo experiments and sampling techniques
- To learn statistical analysis on data
- To understand statistical tests using tools
- To understand statistical analysis using graphical and numerical methods

UNIT I	DESCRIPTIVE STATISTICS	9

Diagrammatic representation of data, measures of central tendency, measures of dispersion, measures of skewness and kurtosis, correlation, inference procedure for correlation coefficient, bivariate correlation, multiple correlations, linear regression and its inference procedure, multiple regression.

Probability: Measures of probability, conditional probability, independent event, Bayes' theorem, random variable, discrete and continuous probability distributions, expectation and variance, markov inequality, chebyshev's inequality, central limit theorem.

CO1

UNIT II	INFERENTIAL STATISTICS	9

Sampling & Confidence Interval, Inference & Significance. Estimation and Hypothesis Testing, Goodness of fit, Test of Independence, Permutations and Randomization Test, ttest/z-test (one sample, independent, paired), ANOVA, chi-square.

Linear Methods for Regression Analysis: multiple regression analysis, orthogonalization by Householder transformations (QR); singular value decomposition (SVD); linear dimension reduction using principal component analysis (PCA)

CO2

UNIT III	PSEUDO-RANDOM NUMBERS AND MANTE CARLO INTEGRATION	9

Pseudo-Random Numbers: Random number generation, Inverse-transform, acceptance-rejection, transformations, multivariate probability calculations.

Monte Carlo Integration: Simulation and Monte Carlo integration, variance reduction, Monte Carlo hypothesis testing, antithetic variables/control variates, importance sampling, stratified sampling Markov chain Monte Carlo (McMC): Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence

CO3

UNIT IV	RESAMPLING METHODS, DENSITY ESTIMATION, & NUMERICAL METHODS	9

Resampling Methods: Cross-validation, Bootstrapping, Jackknife resampling, percentile confidence intervals, permutation tests

Density Estimation: Univariate density estimation, kernel smoothing, multivariate density estimation

Numerical Methods: Root finding; more on numerical integration; numerical maximization/minimization; constrained and unconstrained optimization; EM (Expectation Maximization) algorithm; simplex algorithm

CO4

UNIT V	INTRODUCTION TO R PROGRAMMING	9

History of R programming, starting and ending R, R as a scientific calculator, handling package, workspace, inspecting variables, operators and expressions in R, data objects and types, vectors, matrices and arrays, lists and data frames, built-in and user-defined functions , strings and factors, flow control and loops, advanced looping, date and times.

Using R for statistical analysis: Importing data files, exporting data, outputting results, exporting graphs, graphics in R, interactively adding information of plot, performing data analysis tasks. R commands for descriptive statistics, data aggregation, representation of multivariate data, code factorization and optimization, statistical libraries in R

CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. S.C. Gupta & V.K. Kapoor, “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons
2. Sheldon M. Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Press
3. Dudewicz, E.J., Mishra, S.N., “Modern Mathematical Statistics”, Willy
4. Purohit S. G., Gore S. D., Deshmukh S. K., “Statistics using R, Narosa
5. Rizzo, M. L., “Statistical Computing with R”, Boca Raton, FL: Chapman & Hall/CRC Press

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand and apply the probability distributions, random number generation and density estimations to perform analysis of various kinds of data
CO2	Understand and manipulate data, design and perform simple Monte Carlo experiments, and be able to use resampling methods
CO3	Perform statistical analysis on variety of data
CO4	Perform appropriate statistical tests using R and visualize the outcome
CO5	Discuss the results obtained from their analyses after creating customized graphical and numerical summaries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO2	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO3	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO4	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2
CO5	3	3	3	-	2	-	-	2	2	2	-	2	3	3	2

SEMESTER VIII
PROFESSIONAL ELECTIVE – VI

DS1821	COGNITIVE SYSTEMS	L	T	P	C
	Common for AI-DS & AI-ML	3	0	0	3

OBJECTIVES

- To provide an understanding of the central challenges in realizing aspects of human cognition.
- To provide a basic exposition to the goals and methods of human cognition.
- To develop algorithms that use AI and machine learning along with human interaction and feedback to help humans make choices/decisions.
- To support human reasoning by evaluating data in context and presenting relevant findings along with the evidence that justifies the answers.

UNIT I	INTRODUCTION TO COGNITIVE SCIENCE	9
Understanding Cognition, IBM's Watson, Design for Human Cognition, Augmented Intelligence, Cognition Modeling Paradigms: Declarative/ logic-based computational cognitive modeling, connectionist models of cognition, Bayesian models of cognition, a dynamical systems approach to cognition.		CO1
UNIT II	**MODELS**	**9**
Cognitive Models of memory and language, computational models of episodic and semantic memory, modeling psycholinguistics.		CO2
UNIT III	**COGNITIVE MODELING**	**9**
modeling the interaction of language, memory and learning, Modeling select aspects of cognition classical models of rationality, symbolic reasoning and decision making.		CO3
UNIT IV	**INDUCTIVE GENERALIZATION**	**9**
Formal models of inductive generalization, causality, categorization and similarity, the role of analogy in problem solving, Cognitive Development Child concept acquisition. Cognition and Artificial cognitive architectures such as ACT-R, SOAR, OpenCog, CopyCat, Memory Networks.		CO4
UNIT V	**APPLICATION**	**9**
DeepQA Architecture, Unstructured Information Management Architecture (UIMA), Structured Knowledge, Business Implications, Building Cognitive Applications, Application of Cognitive Computing and Systems		CO5
	TOTAL : 45 PERIODS	

REFERENCE BOOKS

1. Formal Approaches in Categorization by Emmanuel M. Pothos, Andy J. Wills, Cambridge University Press,2012.
2. Cognition, Brain and Consciousness: Introduction to Cognitive Neuroscience by Bernard J. Bears, Nicole M. Gage, Academic Press,2013.
3. Cognitive Computing and Big Data Analytics by Hurwitz, Kaufman, and Bowles, Wiley,2012.
4. The Cambridge Handbook of Computational Psychology by Ron Sun (ed.), Cambridge University Press,2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand what cognitive computing and it's models
CO2	Understand how it differs from traditional approaches.
CO3	Plan and use the primary tools associated with cognitive computing.
CO4	Plan and execute a project that leverages cognitive computing.
CO5	Understand and develop the business implications of cognitive computing.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	2	-	-	-	-	2	2	2	3	2	2

DS1822	PARALLEL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the development of parallel and massively parallel systems.
- To understand the challenges in heterogeneous processing systems.
- To Use shared programming models for parallel programs.
- To learn to program heterogeneous systems.
- To learn to provide effective parallel solutions for GPGPU architectures.

UNIT I	PARALLEL COMPUTING BASICS	9
Importance of Parallelism – Processes, Tasks and Threads – Modifications to von-Neumann model – ILP – TLP – Parallel Hardware – Flynns Classification – Shared Memory and Distributed Memory Architectures – Cache Coherence – Parallel Software – Performance – Speedup and Scalability – Massive Parallelism – GPUs – GPGPUs.		CO1
UNIT II	**SHARED MEMORY PROGRAMMING WITH OPENMP**	**9**
OpenMP Program Structure – OpenMP Clauses and Directives – Scheduling Primitives – Synchronization Primitives – Performance Issues with Caches – Case Study – Tree Search.		CO2
UNIT III	**PROGRAMMING GPUS**	**9**
GPU Architectures – Data Parallelism – CUDA Basics – CUDA Program Structure – Threads, Blocks, Grids – Memory Handling.		CO3
UNIT IV	**PROGRAMMING WITH CUDA**	**9**
Parallel Patterns – Convolution – Prefix Sum – Sparse matrix – Vector Multiplication – Imaging Case Study.		CO4
UNIT V	**OTHER GPU PROGRAMMING PLATFORMS**	**9**
Introduction to OpenCL – OpenACC – C++AMP – Thrust – Programming Heterogeneous Clusters – CUDA and MPI.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. Peter Pacheco, “Introduction to Parallel Programming”, Morgan Kauffman, 2011.
2. David B. Kirk, Wen–mei W. Hwu, “Programming Massively Parallel Processors”, Third Edition, Morgan Kauffman, 2016.

REFERENCE BOOKS

1. Shane Cook, “CUDA Programming – A Developers Guide To Parallel Computing with GPUs”, Morgan Kauffman, 2013.
2. B.R. Gaster, L. Howes, D.R. Kaeli, P. Mistry, D. Schaa, “ Heterogeneous Computing with OpenCL 2.0”, Morgan Kauffman, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify and Choose the right parallel processing paradigm for a given problem.
CO2	Write parallel programs using OpenMP
CO3	Devise solutions for an application on a heterogeneous multi-core platform.
CO4	Program GPUs using CUDA / OpenCL.
CO5	Compare characteristics of and evaluate different GPU programming platforms.

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	2	2

DS1823	BIO-INSPIRED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

UNIT I	INTRODUCTION	9
Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.		CO1
UNIT II	**RANDOM WALK AND ANEALING**	**9**
Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.		CO2
UNIT III	**GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION**	**9**
Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.		CO3
UNIT IV	**SWARM OPTIMIZATION AND FIREFLY ALGORITHM**	**9**
Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients- Ant colony optimization toward feature selection.		CO4
UNIT V	**APPLICATION IN IMAGE PROCESSING**	**9**
Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016.

REFERENCE BOOKS

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014.
4. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement and apply bio-inspired algorithms
CO2	Explain random walk and simulated annealing
CO3	Implement and apply genetic algorithms
CO4	Explain swarm intelligence and ant colony for feature selection
CO5	Apply bio-inspired techniques in image processing

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	3	3	2	-	-	-	2	2	2	3	3	2

DS1824	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic components of Storage System Environment.
- To understand the Storage Area Network Characteristics and Components.
- To examine emerging technologies including IP-SAN.
- To consider the factors which optimize the information retrieval process;
- To examine current issues in information retrieval.

UNIT I	STORAGE SYSTEMS	9
Introduction to Information Storage and Management: Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle. Storage System Environment: Components of the Host. RAID: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares. Intelligent Storage System: Components, Intelligent Storage Array.		**CO1**
UNIT II	**STORAGE NETWORKING TECHNOLOGIES**	**9**
Direct-Attached Storage and Introduction to SCSI: Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI, SCSI Command Model. Storage Area Networks: Fiber Channel, SAN Evolution, SAN Components, Fiber Channel Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, Fiber Channel Topologies. Network Attached Storage: Benefits of NAS, NAS File I/Components of NAS, NAS Implementations, NAS-Implementations, NAS File Sharing Protocols, NAS I/O Operations.		**CO2**
UNIT III	**ADVANCED STORAGE NETWORKING AND VIRTUALIZATION**	**9**
IP SAN: iSCSI, FCIP. Content-Addressed Storage: Fixed Content and Archives, Types of Archives, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples. Storage Virtualization: Forms of Virtualization, NIA Storage Virtualization Taxonomy, Storage Virtualization Configurations, Storage Virtualization Challenges, Types of Storage Virtualization.		**CO3**
UNIT IV	**BUSINESS CONTINUITY**	**9**
Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Recovery: Backup Purpose, Considerations, Granularity, Recovery Considerations, Backup Methods and Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.		**CO4**
UNIT V	**REPLICATION**	**9**
Local Replication: Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface. Remote Replication: Modes of Remote Replication and its technologies, Network Infrastructure.		**CO5**
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, —Building Storage Networksǁ, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, —Storage Networks: The Complete Reference—, Tata McGraw Hill, Osborne, 2003.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Select from various storage technologies to suit for required application.
CO2	Apply theories to effectively solve information retrieval problems in real world situations.
CO3	Apply security measures to safeguard storage & farm.
CO4	Analyze QoS on Storage.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO2	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO3	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO4	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2
CO5	3	3	3	3	2	2	-	-	-	2	2	2	3	2	2

MG1825	ENGINEERING ECONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Acquire knowledge of economics to facilitate the process of economic decision making
- To analyze cost/revenue data and carry out make economic analyses in the decision-making process to justify or reject alternatives/projects on an economic basis.
- To obtain professional licensure
- To function in the business and management side of professional engineering practice.
- Prepare engineering and computer science students to write technical reports.

UNIT I	INTRODUCTION TO ECONOMICS	9
Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis – V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.		**CO1**
UNIT II	**VALUE ENGINEERING**	**9**
Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor – Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.		**CO2**
UNIT III	**CASH FLOW**	**9**
Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.		**CO3**
UNIT IV	**REPLACEMENT AND MAINTENANCE ANALYSIS**	**9**
Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.		**CO4**
UNIT V	**DEPRECIATION**	**9**
Depreciation- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, Inflation adjusted decisions – procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Pravin Kumar, " Engineering Economy Management" Wiley Publication,2019.
2. R.Panneerselvam, "Engineering Economics", PHI, 2013.

REFERENCE BOOKS

1. Zahid A. Khan , Arshad N. Siddiquee, Brajesh Kumar, Mustufa H. Abidi , "Principles of Engineering Economics with Applications", Cambridge,Second Edition, 2018.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Evaluate the economic theories, cost concepts and pricing policies
CO2	Understand the market structures and integration concepts
CO3	Understand the measures of national income, the functions of banks and concepts of globalization
CO4	Provide the students with a basic understanding of replacement analysis.
CO5	Understand ethical business practices.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO2	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO3	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO4	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2
CO5	3	3	3	2	-	-	-	-	-	2	2	2	3	2	2

OPEN ELECTIVES – I & II

OBT101	INDUSTRIAL BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- To motivate students to excel in research and to practice the technologies in the field of Industrial biotechnology. To provide students with a solid understanding of Biotechnology fundamentals and applications required to solve real life problems. To provide students with an academic environment that is aware of professional excellence and leadership through interaction with professional bodies

UNIT I	OVERVIEW OF THE CELL	9
Cell, structure and properties, prokaryotic and eukaryotic cells, structural organization and function of intracellular organelles; Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic reticulum, Peroxisomes and Chloroplast.		CO1
UNIT II	**MICROBIAL GROWTH: PURE CULTURE TECHNIQUES**	**9**
Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. The definition of growth, mathematical expression of growth, Growth curve, availability of oxygen, culture collection and maintenance of cultures. Media formulation: principles of microbial nutrition, formulation of culture medium, selective media, factors influencing the choice of various carbon and nitrogen sources, vitamins, minerals, precursors and antifoam agents. Importance of pH.		CO2
UNIT III	**MANAGEMENT OF WASTE**	**9**
Management of Contaminated land, lake sediments and Solid Waste, Anaerobic digestion, Biostimulation, Bioaugmentation, Phytoremediation, Natural attenuation, Vermicomposting		CO3
UNIT IV	**BIOREMEDIATION**	**9**
Definition, constraints and priorities of Bioremediation, Types of bioremediation, In-situ and Ex-situ bioremediation techniques, Factors affecting bioremediation. Bioremediation of Hydrocarbons. Lignocellulosic Compounds.		CO4
UNIT V	**BIOENERGY AND BIOMINING**	**9**
Bio energy: Energy and Biomass Production from wastes, biofuels, bio hydrogen and biomass. Biomining: Bioleaching, monitoring of pollutants, microbially enhanced oil recovery, microbial fuel cells.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Molecular Biology of cell, Alberts. B et al. Developmental Biology, SF Gilbert, Sinauer Associates Inc.
2. AVN Swamy, Industrial Pollution Control Engineering, 2006, Galgotia Publication,

REFERENCE BOOKS

1. Environmental Biotechnology - Allan Stagg.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design, perform experiments, analyze and interpret data for investigating complex problems in Biotechnology, Engineering and related fields.
CO2	Decide and apply appropriate tools and techniques in biotechnological manipulation.
CO3	Justify societal, health, safety and legal issues
CO4	Understand his responsibilities in biotechnological engineering practices
CO5	Understand the need and impact of biotechnological solutions on environment and societal context keeping in view need for sustainable solution.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	2	1	1	2	2	4	2	1	1	1	2	1	1
CO2	2	1	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	3	3	2	1	1	2	4	3	1	2	4	5	1	2	2
CO4	3	3	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	4	5	2	4	3	2	1	2	3	1	1	2	2

OBT104	BIOSENSORS	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	PROTEIN BASED BIOSENSORS	9
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		CO1
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		CO2
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**
Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		CO3
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		CO4
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OBT105	INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE

- Understand the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

UNIT I	BASICS OF NANOTECHNOLOGY	9
Introduction - Time and length scale in structures -Definition of a nanosystem -Dimensionality and size dependent phenomena -Surface to volume ratio -Fraction of surface atoms - Surface energy and surface stress- surface defects-Effect of nanoscale on various properties - Structural, thermal, mechanical, magnetic, optical and electronic properties.		CO1
UNIT II	**DIFFERENT CLASSES OF NANOMATERIALS**	**9**
Classification based on dimensionality-Quantum Dots,Wells and Wires - Carbon based nano materials (buckyballs, nanotubes, grapheme) - Metal based nanomaterials (nanogold, nanosilver and metal oxides) - Nanocomposites-Nanopolymers - Nano ceramics -Biological nanomaterials.		CO2
UNIT III	**SYNTHESIS OF NANOMATERIALS**	**9**
Chemical Methods: Metal Nanocrystals by Reduction -Sol - gel processing - Solvothermal Synthesis - Photochemical Synthesis - Chemical Vapor Deposition(CVD) - Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods: Ball Milling - Electrodeposition - Spray Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE).		CO3
UNIT IV	**CHARACTERIZATION OF NANOSTRUCTURES**	**9**
Introduction, structural characterization, X-ray diffraction (XRD-Powder/Single crystal), Small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM) - Energy Dispersive X-ray analysis (EDAX)- Transmission Electron Microscope (TEM) - Scanning Tunneling Microscope (STM)-Atomic Force Microscopy (AFM), UV-vis spectroscopy (liquid and solid state) - Raman Spectroscopy -X-ray Photoelectron Spectroscopy (XPS) - Auger Electron spectroscopy (AES).		CO4
UNIT V	**APPLICATIONS**	**9**
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with a special architecture - Liquid crystalline systems - Applications in displays and other devices -Nanomaterials for data storage -Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Nano Technology: Basic Science and Emerging Technologies, Mick Wilson, Kamali Kannargare., Geoff Smith Overseas Press (2005)
2. A Textbook of Nanoscience and Nanotechnology,Pradeep T., Tata McGrawHill Education Pvt. Ltd., 2012.
3. Nanostructured Materials and Nanotechnology,Hari Singh Nalwa,Academic Press, 2002.
4. Introduction to Nanotechnology, Charles P.Poole, FrankJ.Owens, Wiley Interscience (2003)
5. Textbook of Nanoscience and Nanotechnology, B.S. Murty, P. Shankar, Baldev Raj, B BRath, James Murday, Springer Science & Business Media, 2013.

REFERENCE BOOKS

1. Nanotechnology: A gentle introduction to the next Big idea, Mark A.Ratner, Daniel Ratner, Mark Ratne, Prentice Hall P7R:1st Edition (2002)
2. Fundamental properties of nanostructed materials Ed D. Fioran, G.Sberveglier, World Scientific 1994
3. Nanoscience: Nanotechnologies and Nanophysics, Dupas C., Houdy P., Lahmani M., Springer-Verlag Berlin Heidelberg, 2007

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology
CO2	Understand the different classes of nanomaterials.
CO3	Identify the CVD, MOCVD
CO4	Outline the applications of nanotechnology and
CO5	Develop an ability to critically evaluate the promise of a nanotechnology device.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	1

OCE102	INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data models.
- To know the details of data input and topology
- To know the knowledge on data management and output processes
- To know the data quality and standards

UNIT I	FUNDAMENTALS OF GIS	9
Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open-source Software - Types of data – Spatial, Attribute data- types of attributes – scales/ levels of measurements.		CO1
UNIT II	**SPATIAL DATA MODELS**	**9**
Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector ModelsTIN and GRID data models - OGC standards - Data Quality.		CO2
UNIT III	**DATA INPUT AND TOPOLOGY**	**9**
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.		CO3
UNIT IV	**DATA ANALYSIS**	**9**
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.		CO4
UNIT V	**APPLICATIONS**	**9**
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition,2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver,Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2ndEdition,2007.

REFERENCE BOOKS

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers,2006

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Have basic idea about the fundamentals of GIS.
CO2	Understand the types of data models.
CO3	Get knowledge about data input and topology.
CO4	Gain knowledge on data quality and standards.
CO5	Understand data management functions and data output

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO2	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2
CO3	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO4	2	2	1	1	2	-	1	-	-	-	-	2	2	2	1
CO5	2	2	1	1	2	-	1	-	-	-	-	2	2	2	2

OCH101	HOSPITAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the fundamentals of hospital administration and management.
- To know the market related research process and its HRM
- To understand the recruitment and training processes in hospitals
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I	OVERVIEW OF HOSPITAL ADMINISTRATION	9
Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning		CO1
UNIT II	**HUMAN RESOURCE MANAGEMENT IN HOSPITAL**	**9**
Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.		CO2
UNIT III	**RECRUITMENT AND TRAINING**	**9**
Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.		CO3
UNIT IV	**SUPPORTIVE SERVICES**	**9**
Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.		CO4
UNIT V	**COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL**	**9**
Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.		CO5
	TOTAL : 45 PERIODS	

TEXT BOOKS

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI – Fourth Edition, 2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCE BOOKS

1. Cesar A.Caceres and Albert Zara, “The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman “Health Sector Reform in Developing Countries” - Harvard University Press, 1995.
4. William A. Reinke “Health Planning For Effective Management” - Oxford University Press.1988
5. Blane, David, Brunner, “Health and SOCIAL Organization: Towards a Health Policy for the 21st Century”, Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, “Health Care Management”, 6th Edition Cengage Learning, 2011.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Explain the principles of Hospital administration.
CO2	Identify the importance of Human resource management.
CO3	List various marketing research techniques.
CO4	Identify Information management systems and issues in supporting departments of hospitals
CO5	Understand safety procedures followed in hospitals

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1

OEC103	BASICS OF EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the concepts of IoT

UNIT I	INTRODUCTION TO EMBEDDED SYSTEM	9
Complex systems and microprocessors– Embedded system design process - Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques–Design example: Model train controller.		CO1
UNIT II	**BASICS OF ARM ARCHITECTURE AND PERIPHERAL INTERFACING**	**9**
ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU		CO2
UNIT III	**EMBEDDED PROGRAMMING CONCEPTS**	**9**
Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing		CO3
UNIT IV	**INTRODUCTION TO IoT**	**9**
Functional blocks of an IoT system - Basics of Physical and logical design of IoT - IoT enabled domains - Difference between IoT - Passive and active sensors - Different applications of sensors - IoT front-end hardware Case Studies – Smart Parking, Air Pollution Monitoring.		CO4
UNIT V	**COMMUNICATION PROTOCOLS FOR EMBEDDED AND IoT**	**9**
Embedded Networking: Introduction-Serial/Parallel Communication - Serial communication protocols- RS485 - Synchronous Serial Protocols - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C). IoT Infrastructure - 6LowPAN - IPv6 - Wi-Fi, Bluetooth, ZigBee.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, IV)
2. Arshdeep Bahga, Vijay Madisetti, “Internet of Things, A Hands-on-Approach”, 1st Edition, Universities press Pvt. Ltd., India, 2015.
3. Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6, 1st Edition, John Wiley & Sons”, Inc, USA, 2013

REFERENCE BOOKS

a. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, 1st Edition, John Wiley & Sons Ltd, UK, 2014
b. Peter Waher, “Learning Internet of Things”, 1st Edition, Packt Publishing Ltd, UK, 2015.
c. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi” , 1st Edition, Apress Publishers, USA, 2013.
d. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw-Hill, 2017

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the Embedded System Design Process
CO2	Describe the architecture and programming of ARM processor
CO3	Outline the concepts of embedded system programming
CO4	Explain the basic concepts of IOT
CO5	Model Networked systems with basic protocols

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	3	-	2	1	2	-	1	2	2	3	3	2
CO2	3	3	2	3	-	3	1	2	-	1	2	2	3	3	2
CO3	3	3	2	3	3	3	1	2	1	1	2	2	3	3	2
CO4	3	3	3	3	-	2	1	2	-	1	2	2	3	3	2
CO5	3	3	3	3	2	3	1	2	1	1	2	2	3	3	2

OEE101	BASIC CIRCUIT THEORY	L	P	T	C
		3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I	BASIC CIRCUITS ANALYSIS	9
Resistive elements - Resistors in series and parallel circuits; Ohm's Law; Kirchoffs laws – methods of analysis-Mesh current and node voltage.		CO1
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS**	**9**
Network reduction- voltage and current division, source transformation, star delta conversion; Network theorems- Thevenins and Norton Theorems, Superposition Theorem, Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		CO2
UNIT III	**ANALYSIS OF AC CIRCUITS**	**9**
Introduction to AC circuits- Inductive reactance, Capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor; RL, RC , RLC networks; Network reductions- voltage and current division, source transformation; Mesh and node analysis; Network theorems- Thevenins and Norton Theorems, Superposition Theorem , Maximum power transfer theorem, Reciprocity Theorem, Millman's theorem.		CO3
UNIT IV	**THREE PHASE CIRCUITS**	**9**
A.C. circuits – Average and RMS value, Phasor Diagram, Power, Power Factor and Energy; Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced; phasor diagram of voltages and currents; power measurement in three phase circuits.		CO4
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	**9**
Series and parallel resonance – frequency response, Quality factor and Bandwidth; Self and mutual inductance; Coefficient of coupling; Tuned circuits – Single tuned circuits.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits",Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw- Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd.,New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”,McGraw Hill, 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Ability to introduce electric circuits and its analysis
CO2	Ability to impart knowledge on solving circuit equations using network theorems
CO3	Ability to introduce the phenomenon of resonance in coupled circuits.
CO4	Ability to introduce Phasor diagrams and analysis of three phase circuits
CO5	Ability to impart knowledge on resonance and coupled circuits

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEE103	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L	P	T	C
		3	0	0	3

OBJECTIVES

- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

UNIT I	INTRODUCTION	9
Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.		CO1
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Reference theory fundamentals-principle of operation and analysis: IG and PMSG		CO2
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers		CO3
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Standalone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system		CO4
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan, "Non-conventional Energy Sources", Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCE BOOKS

1. Muhammad H. Rashid, "Power Electronics Hand Book", Third Edition, Butterworth-Heinemann, 2015.
2. Ion Boldea, "Variability Speed Generators", Second Edition, CRC Press, 2015.
3. Rai. G.D, "Non- conventional Energy Sources", Khanna Publishers, 2004.
4. Gray, L. Johnson, "Wind Energy Systems", Prentice Hall, 2006.
5. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", Third Edition, Wiley India Pvt. Ltd, 2016.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Ability to understand and analyze power system operation, stability, control and protection.
CO2	Ability to handle the engineering aspects of electrical energy generation and utilization.
CO3	Ability to understand the stand alone and grid connected renewable energy systems.
CO4	Ability to design of power converters for renewable energy applications.
CO5	Ability to acquire knowledge on wind electrical generators and solar energy systems.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

OEI102	ROBOTICS	L	T	P	C
		3	0	0	3

OBJECTIVE

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I	FUNDAMENTALSOF ROBOT	9
Robot - Definition - Robot Anatomy - Coordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load-Robot Parts and their Functions-Need for Robots-Different Applications.		**CO1**
UNIT II	**ROBOT DRIVE SYSTEMS ANDEND EFFECTORS**	**9**
Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.		**CO2**
UNIT III	**SENSORS AND MACHINEVISION**	**9**
Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.		**CO3**
UNIT IV	**ROBOT KINEMATICS AND ROBOTPROGRAMMING**	**9**
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.		**CO4**
UNIT V	**IMPLEMENTATION ANDROBOTECONOMICS**	**9**
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill,2001.

REFERENCE BOOKS

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education,2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co.,1994.
3. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co.,1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill,1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company,2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd.,1991.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the functions of the basic components of a Robot.
CO2	Study the use of various types of End of Effectors and Sensors
CO3	Understand Sensors and Machine Vision of Robot
CO4	Understand Robot Kinematics and Robot Programming
CO5	Understand the Implementation of Robots in Industries

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	-	-	-	-	2	2	3	2	1	2
CO2	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO3	3	3	1	2	2	-	-	-	-	2	2	3	3	2	2
CO4	3	2	1	2	2	-	-	-	-	2	2	3	3	2	2
CO5	2	2	1	2	2	-	-	-	-	2	2	3	2	2	2

OMB101	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the quality philosophies and tools in the managerial perspective.

UNIT I	INTRODUCTION	9
Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.		CO1
UNIT II	**PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT**	**9**
Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology		CO2
UNIT III	**STATISTICAL PROCESS CONTROL**	**9**
Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve.Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations.		CO3
UNIT IV	**TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT**	**9**
Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.		CO4
UNIT V	**QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION**	**9**
Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Dale H.Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011
2. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, First Edition 2002.

REFERENCE BOOKS

1. Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student Edition, 4th Edition, Wiley India Pvt Limited, 2008.
2. James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005.
3. Poornima M.Charantimath, Total Quality Management, Pearson Education, First Indian Reprint 2003.
4. Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

COURSE OUTCOMES

At the end of the course, the student should be able:

CO1	To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.
CO2	To understand the principles of business process improvement
CO3	To understand and apply the concepts of statistical process control
CO4	To apply the tools and techniques used for quality management
CO5	To understand the methods in organizing and implementation of quality systems

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	3	3	-	-	-	-	2	2	2	1	1	1
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO3	3	3	2	3	3	-	-	-	-	2	2	2	1	1	1
CO4	2	3	3	3	2	-	-	-	-	2	2	2	1	1	1
CO5	3	3	2	3	2	-	-	-	-	2	2	2	1	1	1

OME104	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948
- To familiarize students with powers of inspectorate of factories
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.
- To prepare onsite and offsite emergency plan.

UNIT I	FACTORIES ACT – 1948	9
Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Tamil Nadu Factories Rules 1950 under Safety and health chapters of Factories Act 1948		CO1
UNIT II	**ENVIRONMENT ACT – 1986**	**9**
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.		CO2
UNIT III	**MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989**	**9**
Definitions – duties of authorities – responsibilities of occupier – notification of major accidents – information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.		CO3
UNIT IV	**OTHER ACTS AND RULES**	**9**
Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act		CO4
UNIT V	**INTERNATIONAL ACTS AND STANDARDS**	**9**
Occupational Safety and Health act of USA (The Williames - Steiger Act of 1970) – Health and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
3. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt.Ltd., New Delhi.

REFERENCE BOOKS

1. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt.Ltd., New Delhi.
2. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt.Ltd., Allahabad.
3. The manufacture, storage and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To list out important legislations related to health, Safety and Environment.
CO2	To list out requirements mentioned in factories act for the prevention of accidents.
CO3	To understand the health and welfare provisions given in factories act.
CO4	To understand the statutory requirements for an Industry on registration, license and its renewal.
CO5	To prepare onsite and offsite emergency plan.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO2	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO3	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO4	2	1	-	-	1	2	2	2	2	1	2	2	1	1	1
CO5	2	2	-	-	1	2	2	2	2	2	2	2	1	1	1

OTHER COURSES OFFERED BY CSE

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (LAB INTEGRATED)	L	T	P	C
	Common to EEE and EIE	3	0	2	4

OBJECTIVES

- ❖ To learn the basics of C Programming
- ❖ To learn the advanced features of C Programming
- ❖ To explore the applications of linear data structures
- ❖ To learn about how to represent and implement non-linear data structure
- ❖ To learn about the basics of sorting, searching and Hash Table.

UNIT I	C PROGRAMMING BASICS	9 + 6

Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays.

Lab Component

- Implementation of basic c programs
  a. Find greatest of three numbers
  b. Create a simple Calculator
- Implementation of array
  a. Computing Mean, Median and Mode
  b. Matrix Addition

CO1

UNIT II	FUNCTIONS, POINTERS AND STRUCTURES	9 + 6

Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation.

Lab Component

- Implementation of user defined data types
  a. Computation of Sine series.
  b. Swapping of two numbers and changing the value of a variable using pass by reference

CO2

UNIT III	LINEAR DATA STRUCTURES	9 + 6

List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue.

Lab Component

- Implementation of linear data structure
  a. List implementation of List, Stack, Queue.
  b. Implement polynomial addition using list.
  c. Evaluate arithmetic expression.

CO3

UNIT IV	NON-LINEAR DATA STRUCTURES	9 + 6
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs. **Lab Component** • Implementation of tree a. Construct binary search tree. b. Traverse the binary tree recursively in pre-order, post-order and in-order. • Graph traversal a. Depth first search b. Breadth first search.		**CO4**
UNIT V	**SEARCHING, SORTING AND HASH TABLE**	**9 + 6**
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling. **Lab Component** • Sorting & Searching a. Insertion sort b. Merge sort c. Linear Search d. Binary Search		**CO5**

THEORY : 45 PERIODS
PRACTICAL : 30 PERIODS
TOTAL : 45 PERIODS

TEXT BOOKS

1. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

CS1516	VISUAL PROGRAMMING	L	T	P	C
	Common to EEE and EIE	3	0	0	3

OBJECTIVES

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variability's, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB

UNIT I	FUNDAMENTALS OF WINDOWS AND MFC	9
Messages : Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.		**CO1**
UNIT II	**RESOURCES AND CONTROLS**	**9**
Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.		**CO2**
UNIT III	**DOCUMENT / VIEW ARCHITECTURE**	**9**
The in existence function revisited – Document object – View object – Frame window object Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in app wizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializability classes.		**CO3**
UNIT IV	**FUNDAMENTALS OF VISUAL BASIC**	**9**
Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming. Variabilitys: Declaration – Types – Converting variability types – User defined data types - Lifetime of a variability. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.		**CO4**

UNIT V	DATABASE PROGRAMMING WITH VB	9
Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Tability def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements–Cursortypes and locking mechanism–Manipulating the record set object – Simple record editing and updating.		**CO5**

TOTAL : 45 PERIODS

TEXT BOOKS

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted,2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications,2002.

REFERENCE BOOKS

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, McGraw Hill, reprinted,2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', McGraw Hill, Reprinted,2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Tech media Pub,1999.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand study about the concepts of windows programming models.
CO2	Understand the concepts of Menu basics, menu magic and classic controls.
CO3	Understand the concept of Document/View Architecture with single & multiple document interface.
CO4	Understand the integrated development programming event driven document interface.
CO5	Understand the database and the database management system programming.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	1	1	1	1	2	1	1	3	2	2
CO2	3	2	1	1	1	1	1	1	1	2	1	2	3	2	2
CO3	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2
CO4	2	1	1	1	1	1	1	1	1	1	1	2	3	2	2
CO5	2	2	1	1	1	1	1	1	1	1	1	2	3	2	2

OPEN ELECTIVE COURSES OFFERED BY CSE

OCS101	INTRODUCTION TO C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts in C Programming Language.
- To understand Input and Output Statements.
- To enhance analyzing and problem solving skills and use the same for writing programs in C.
- To familiarize the basic syntax in arrays and pointers
- To provide exposure to problem-solving through programming

UNIT I	INTRODUCTORY CONCEPTS & C FUNDAMENTALS	9
Introduction to Computers - Computer Characteristics - Modes of Operation - Types of Programming Languages - Introduction to C - Some Simple C Programs - Desirable Program Characteristics - The C Character Set - Identifiers and Keywords - Data Types - Constants - Variables and Arrays - Declarations - Expressions - Statements - Symbolic Constants.		**CO1**
UNIT II	**OPERATORS, EXPRESSIONS, DATA INPUT & OUTPUT AND CONTROL STATEMENTS**	**9**
Arithmetic Operators - Unary Operators - Relational and Logical Operators - Assignment Operators - The Conditional Operator - Library Functions - getchar, putchar, scanf, printf, gets and puts Functions - Preliminaries - Branching: The if else Statement - Looping: The while Statement - do while Statement - for Statement - Nested Control Structures - The switch Statement - The break Statement - The continue Statement - The Comma Operator - The goto Statement		**CO2**
UNIT III	**FUNCTIONS & PROGRAM STRUCTURE**	**9**
Defining a Function - Accessing a Function - Function Prototypes - Passing Arguments to a Function – Recursion - Storage Classes - Automatic Variables - External (Global) Variables - Static Variables - Multifile Programs - More About Library Functions		**CO3**
UNIT IV	**ARRAYS & POINTERS**	**9**
Defining an Array - Processing an Array - Passing Arrays to Functions - Multidimensional Arrays - Arrays and Strings - Fundamentals - Pointer Declarations - Passing Pointers to Functions - Pointers and One-Dimensional Arrays - Dynamic Memory Allocation - Operations on Pointers - Pointers and Multidimensional Arrays - Arrays of Pointers - Passing Functions to Other Functions		**CO4**
UNIT V	**STRUCTURES, UNIONS & DATA FILES**	**9**
Defining a Structure - Processing a Structure - User-Defined Data Types (typedef) - Structures and Pointers - Passing Structures to Functions - Self-Referential Structures – Unions - Opening and Closing a Data File - Creating a Data File - Processing a Data File - Unformatted Data Files		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Byron Gottfried - Schaum's Outline of Programming with C, 2nd Edition, McGraw-Hill, 1996.

REFERENCE BOOKS

1. The C Programming Language by Brian Kernighan and Dennis Ritchie 2nd Edition.
2. Let Us C Yashavant kanetkar, BPB

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Identify situations where computational methods and computers would be useful.
CO2	Demonstrate the use of operators, input and output statements and control statements
CO3	Identify solution to a problem and apply control structures and user defined functions for solving the problem
CO4	Demonstrate the use of numeric arrays and pointers
CO5	Demonstrate the ability to design creative solutions to real life problems faced by the industry.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS102	PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the basics of C Programming
- To learn the advanced features of C Programming
- To explore the applications of linear data structures
- To learn about how to represent and implement non-linear data structure
- To learn about the basics of sorting, searching and Hash Table

UNIT I	C PROGRAMMING BASICS	9
Structure of C program – Data Types — Storage classes – Variables— Constants — Keywords — Operators – Input/Output statements, Assignment statements — Decision making statements – Switch statement – Looping statements — Introduction to Arrays: Declaration, Initialization — One dimensional array — Two dimensional arrays.		CO1
UNIT II	**FUNCTIONS, POINTERS AND STRUCTURES**	**9**
Introduction to functions: Function prototype, function definition, function call, Recursion — Pointers — Pointer operators — Pointer arithmetic — Array of pointers — Parameter passing: Pass by value, Pass by reference. Structure – Nested structures — Pointer and Structures — Array of structures — Self-referential structures — Dynamic memory allocation.		CO2
UNIT III	**LINEAR DATA STRUCTURES**	**9**
List – Singly Linked lists – Application of List - Polynomial addition - Linked list implementation of Stacks – Applications of Stack - Evaluating arithmetic expressions - Linked list implementation of Queues – Application of Queue..		CO3
UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9**
Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort – Applications of graphs.		CO4
UNIT V	**SEARCHING, SORTING AND HASH TABLE**	**9**
Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort – Hashing functions - Hash tables – Introduction to Overflow handling.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Reema Thareja, —Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Implement basics of C
CO2	Implement advanced features of C
CO3	Apply the different linear data structures to problem solutions.
CO4	Implement Tree and Graph data structure.
CO5	Analyse the various sorting, searching algorithms and hash table.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To have the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability, benefits, as well as current and future challenges
- To have knowledge on the various virtualization techniques that serve in computation and storage services on the cloud
- To understand the technologies, architecture and applications of cloud computing
- To understand the key security and compliance challenges of cloud computing

UNIT I	INTRODUCTION	9
Introduction to Cloud Computing – Roots of Cloud Computing- Parallel and Distributed Computing, Mainframe and Grid Computing, Desired Features and benefits of Cloud Computing – Challenges and Risks of Cloud Computing		CO1
UNIT II	**VIRTUALIZATION**	**9**
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor and its types, Types of Virtualizations – Hardware, OS, Memory, Application Virtualization, Levels of Virtualization		CO2
UNIT III	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**9**
NIST Cloud Computing Reference Architecture, Layered Cloud Architecture, Architectural Design Challenges – Deployment models of cloud, Services of cloud – Cloud Storage.		CO3
UNIT IV	**RESOURCE MANAGEMENT AND SECURITY IN CLOUD**	**9**
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Architecture-Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.		CO4
UNIT V	**CASE STUDIES**	**9**
Google App Engine (GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services (AWS) – GAE Applications – Cloud Software Environments – Bio-data Platform & Bio Cloud		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, And Security”, CRC Press, 2017.

REFERENCE BOOKS

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO2	Understanding of fundamentals and technological aspects of virtualization along with various terminologies used in Cloud Computing
CO3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO4	Enlighten the core issues of cloud computing such as security, privacy, and interoperability.
CO5	Be familiarization with areas of cloud technologies and working experience in several of them

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	-	1	-	-	-	-	-	-	2	1	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	1	-	-	-	-	-	2	1	-	-	-	2	-	-	1
CO5	2	1	1	-	2	2	-	-	2	-	-	3	2	2	2

OCS104	FUNDAMENTALS OF DATABASE DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study the database design and SQL
- To make the students to understand the fundamentals of Transaction Processing and concurrency
- To have an basic knowledge about the Storage implementation and query processing
- To understand database security concepts and database programming

UNIT I	INTRODUCTION	9
Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – DDL-DML-DCL-TCL- Advanced SQL features - Embedded SQL-Static Vs Dynamic SQL		CO1
UNIT II	**DATABASE DESIGN**	**9**
Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form		CO2
UNIT III	**TRANSACTION CONCEPTS AND CONCURRENCY CONTROL**	**9**
Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Locking -Two Phase Commit Protocol-Dead lock- SQL Facilities for Concurrency and Recovery		CO3
UNIT IV	**IMPLEMENTATION TECHNIQUES**	**9**
RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview –Query optimization using Heuristics and Cost Estimation		CO4
UNIT V	**ADVANCED TOPICS AND DATABASE PROGRAMMING**	**9**
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems. Implementing functions, views, and triggers in MySQL / Oracle. ODBC/JDBC connectivity with front end tools		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. RamezElmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education.
2. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	To understand relational data model, evolve conceptual model of a given problem and SQL
CO2	To understand Relational model and normalization to perform database design effectively
CO3	Apply and relate the concept of transaction, concurrency control and recovery in database
CO4	To understand the implementation technique and query processing
CO5	To understand the concepts of database security and database programming

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	2	1	2	-	1	1	-	1	-	1	1	-	1
CO2	2	-	1	1	1	-	1	1	-	-	-	1	1	-	1
CO3	1	-	1	1	1	1	-	1	-	-	-	1	1	-	1
CO4	2	-	2	1	1	1	-	1	-	-	-	1	1	-	1
CO5	1	-	2	1	2	1	-	1	1	-	-	1	1	-	1

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT I	INTRODUCTION TO DATA ANALYSIS	9
Overview of Data Analytics, Need of Data Analytics, Nature of Data**,** Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		**CO1**
UNIT II	**R PROGRAMMING BASICS**	**9**
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		**CO2**
UNIT III	**DATA VISUALIZATION USING R**	**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. **Working with R Charts and Graphs:** Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		**CO3**
UNIT IV	**STATISTICS WITH R**	**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		**CO4**
UNIT V	**PRESCRIPTIVE ANALYTICS**	**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.
   URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
7. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
8. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2

OCS106	DATA COMMUNICATIONS AND NETWORKING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols

UNIT I	INTRODUCTION AND PHYSICAL LAYER	9
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		CO1
UNIT II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		CO2
UNIT III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		CO3
UNIT IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		CO4
UNIT V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

REFERENCE BOOKS

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

AUDIT COURSES

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I	INTRODUCTION	9
History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features		CO1
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES**	**9**
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties		CO2
UNIT III	**ORGANS OF GOVERNANCE**	**9**
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions		CO3
UNIT IV	**EMERGENCY PROVISIONS**	**9**
Emergency Provisions - National Emergency, President Rule, Financial Emergency		CO4
UNIT V	**LOCAL ADMINISTRATION**	**9**
District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI-Zila Pachayat-Elected officials and their roles- CEO Zila Pachayat- Position and role-Block level Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy		CO5
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Able to understand history and philosophy of Indian Constitution.
CO2	Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO3	Able to understand powers and functions of Indian government.
CO4	Able to understand emergency rule.
CO5	Able to understand structure and functions of local administration.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self destructive habits with value education
- Interpret social empowerment with value education

UNIT I	INTRODUCTION TO VALUE EDUCATION	9
Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgments		CO1
UNIT II	**IMPORTANCE OF VALUES**	**9**
Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline		CO2
UNIT III	**INFLUENCE OF VALUE EDUCATION**	**9**
Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrityand discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering,love for truth.		CO3
UNIT IV	**REINCARNATION THROUGH VALUE EDUCATION**	**9**
Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation		CO4
UNIT V	**VALUE EDUCATION IN SOCIAL EMPOWERMENT**	**9**
Equality, Non violence, Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press ,New Delhi

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge of self-development
CO2	Learn the importance of Human values
CO3	Develop the overall personality through value education
CO4	Overcome the self destructive habits with value education
CO5	Interpret social empowerment with value education

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

OBJECTIVES

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.
- Identify the Research gaps in pedagogy.

UNIT I	INTRODUCTION AND METHODOLOGY	9
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		CO1
UNIT II	**THEMATIC OVERVIEW**	**9**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		CO2
UNIT III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**9**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		CO3
UNIT IV	**PROFESSIONAL DEVELOPMENT**	**9**
Professional development: alignment with classroom practices and follow up support – Peer support - Support from the head teacher and the community - Curriculum and assessment – Barriers to learning: limited resources and large class sizes		CO4
UNIT V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**9**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand the methodology of pedagogy
CO2	Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
CO3	Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Know the factors necessary for professional development.
CO5	Identify the Research gaps in pedagogy.

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

OBJECTIVES

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through Yog Asans
- Invent breathing techniques through Pranayam

UNIT I	INTRODUCTION TO YOGA	9
Definitions of Eight parts of yog.(Ashtanga)		CO1
UNIT II	**YAM**	**9**
Do`s and Don't's in life.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan		CO2
UNIT III	**NIYAM**	**9**
Do`s and Don't's in life. Ahinsa, satya, astheya, bramhacharya and aparigraha		CO3
UNIT IV	**ASAN**	**9**
Various yog poses and their benefits for mind & body		CO4
UNIT V	**PRANAYAM**	**9**
Regularization of breathing techniques and its effects-Types of pranayam		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health also improve efficiency
CO2	Learn Do's and Don't's in life through Yam
CO3	Learn Do's and Don't's in life through Niyam
CO4	Develop a healthy mind and body through Yog Asans
CO5	Learn breathing techniques through Pranayam

MAPPING OF COs WITH POs AND PSOs															
COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO3	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO4	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES

- ❖ Develop basic personality skills holistically
- ❖ Develop deep personality skills holistically to achieve happy goals
- ❖ Rewrite the responsibilities
- ❖ Reframe a person with stable mind

UNIT I	NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I	9
Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)		CO1
UNIT II	**NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II**	**9**
Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)		CO2
UNIT III	**ORGANS OF GOVERNANCE**	**9**
Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48		CO3
UNIT IV	**EMERGENCY PROVISIONS**	**9**
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18		CO4
UNIT V	**LOCAL ADMINISTRATION**	**9**
Chapter 2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter 18 – Verses 37,38,63		CO5
		TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari's ThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram,Publication Department, Kolkata,2016.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To develop basic personality skills holistically
CO2	To develop deep personality skills holistically to achieve happy goals
CO3	To rewrite the responsibilities
CO4	To reframe a person with stable mind, pleasing personality and determination
CO5	To awaken wisdom in students

MAPPING OF COs WITH POs AND PSOs															
COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

OBJECTIVES

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	9
Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **Assignment:** Prepare a map (Physical, visual and digital) of the village you visited and write an essay about inter-family relation in that village.		**CO1**
UNIT II	**RURAL ECONOMY AND LIVELIHOOD**	**9**
Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market. **Assignment:** Describe your analysis of rural household economy, it's challenges and possible pathways to address them. Group discussion in class- (4) Field visit 3.		**CO2**
UNIT III	**RURAL INSTITUTIONS**	**9**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		**CO3**
UNIT IV	**RURAL DEVELOPMENT PROGRAMMES**	**9**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		**CO4**

UNIT V	FIELD WORK	9
Each student selects one programme for field visit Field based practical activities: ❖ Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities ❖ Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site ❖ Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures ❖ Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) ❖ Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization ❖ Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps ❖ Participate in Gram Sabha meetings, and study community participation ❖ Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries ❖ Attend Parent Teacher Association meetings, and interview school drop outs ❖ Visit local Anganwadi Centre and observe the services being provided ❖ Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. ❖ Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys ❖ Raise understanding of people's impacts of climate change, building up community's disaster preparedness ❖ Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants ❖ Formation of committees for common property resource management, village pond maintenance and fishing.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

4. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
5. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
6. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

REFERENCE BOOKS

2. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
3. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand of rural life, culture and social realities
CO2	Understand the concept of measurement by comparison or balance of parameters.
CO3	Develop a sense of empathy and bonds of mutuality with local community
CO4	Appreciate significant contributions of local communities to Indian society and economy
CO5	Value the local knowledge and wisdom of the community

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT I	INTRODUCTION TO CULTURE	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India		CO1
UNIT II	**INDIAN LANGUAGES AND LITERATURE**	**9**
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2
UNIT III	**RELIGION AND PHILOSOPHY**	**9**
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3
UNIT IV	**FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)**	**9**
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India		CO4
UNIT V	**EDUCATION SYSTEM IN INDIA**	**9**
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

COURSE OUTCOMES **Upon completion of the course, students will be able to**	
CO1	Understand philosophy of Indian culture.
CO2	Distinguish the Indian languages and literature.
CO3	Learn the philosophy of ancient, medieval and modern India.
CO4	Acquire the information about the fine arts in India.
CO5	Understand education systems in India

MAPPING OF COs WITH POs AND PSOs

COs	**PROGRAM OUTCOMES (POs)**												**PROGRAM SPECIFIC OUTCOMES (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

OBJECTIVES

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in SangaTamil Literature.
- 'Attruppadai' in SangaTamil Literature.
- 'Puranaanuru' in SangaTamil Literature.
- 'Pathitrupaththu' in SangaTamil Literature.

UNIT I	SANGA TAMIL LITERATURE – AN INTRODUCTION	9
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil SangamLiterature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's GrammarTamil Sangam Literature's parables.		CO1
UNIT II	**'AGATHINAI'AND'PURATHINAI'**	**9**
Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History ofCulturefrom Agathinai– Purathinai–Classification–Mesaage to Society from Purathinai.		CO2
UNIT III	**'ATTRUPPADAI'**	**9**
Attruppadai Literature – Attruppadaiin 'Puranaanuru' – Attruppadaiin 'Pathitrupaththu'- Attruppadaiin 'Paththupaattu'.		CO3
UNIT IV	**'PURANAANURU'**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		CO4
UNIT V	**'PATHITRUPATHTHU'**	**9**
Pathitrupaththuin 'Ettuthogai' – Pathitrupaththu's Parables –Tamildynasty: Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		CO5

TOTAL : 45 PERIODS

REFERENCE BOOKS

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Purananuru,Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
4. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
5. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

COURSE OUTCOMES Upon completion of the course, students will be able to	
CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate ‘Agathinai’ and ‘Purathinai’in their personal and societal life.
CO3	Appreciate and apply the messages in‘ Attruppadai’ in their personal and societal life.
CO4	Appreciate and apply the messages in‘ Puranaanuru’ in their personal and societal life.
CO5	Appreciate and apply the messages in‘ Pathitrupaththu’ in their personal and societal life.

MAPPING OF COs WITH POs AND PSOs

COs	PROGRAM OUTCOMES (POs)												PROGRAM SPECIFIC OUTCOMES (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO3	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO4	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
CO5	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-

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St. JOSEPH'S COLLEGE OF ENGINEERING
(An Autonomous Institution)
St. Joseph's Group of Institutions
Jeppiaar Educational Trust
OMR, Chennai - 119.

FACULTY OF COMPUTER SCIENCE AND ENGINEERING AND INFORMATION TECHNOLOGY

Minutes of the Second Meeting of the Board of Studies

The Second meeting of the Board of Studies for the Faculty of Computer Science and Engineering and Information Technology was held virtually on 20.01.2022 (Thursday), at 11.00 a.m.

***The following Members were present for the meeting*:**

1.	**Chairman**	**Dr. A. Chandrasekar**, Professor and Head, Faculty of Computer Science and Engineering and Information Technology, St. Joseph's College of Engineering, OMR, Chennai – 600 119.
2.	**University Nominee**	**Dr. J. C. Miraclin Joyce Pamila**, Professor and Head, Department of Computer Science and Engineering Government College of Technology Coimbatore – 641 013.
3.	**Subject Expert**	**Dr. Krishna Moorthy Sivalingam**, Professor, Department of Computer Science and Engineering, Indian Institute of Technology (IIT) Madras, Chennai – 600 036.
4.	**Subject Expert**	**Dr. G. Zayaraz**, Professor & Head, Department of Computer Science and Engineering, Puducherry Technological University Puducherry – 605 014.
5.	**Industrial Expert**	**Mr. Abdul Muthalif**, Director Cognizant, Chennai.
6.	**Post Graduate Meritorious Alumnus**	**Ms. S.Ram Lakshmi**, Specialist Programmer Infosys, Techno Park, SEZ, Mahindra World City, Paranur, Chennai.
7.	**Dr.B.Parvatha Varthini**, Dean & Professor of Computer Science and Engineering St. Joseph's College of Engineering, OMR, Chennai – 600 119.	
8.	**Dr. Lilly Raamesh,** Professor & Head, Department of Information Technology, St. Joseph's College of Engineering, OMR, Chennai – 600 119.	

Faculty of Computer Science and Engineering and Information Technology	
9.	Dr.G.Mariakalavathy, Professor of Computer Science and Engineering
10.	Dr.G.Murugesan, Professor of Computer Science and Engineering
11.	Dr.M P Rajakumar, Professor of Computer Science and Engineering
12.	Dr. Kalaivani P, Professor of Information Technology
13.	Dr.Sherly Puspha Annabel L, Professor of Information Technology
14.	Dr.D.Rosy Salomi Victoria, Associate Professor of Computer Science and Engineering
15.	Dr.R. Pugalenthi, Associate Professor of Computer Science and Engineering
16.	Dr.S.Jothi, Associate Professor of Computer Science and Engineering
17.	Dr.J.T.Anita Rose, Associate Professor of Computer Science and Engineering
18.	Dr.F Sangeetha Francelin Vinnarasi, Associate Professor of Computer Science and Engineering
19.	Dr.R.Hemalatha, Associate Professor of Computer Science and Engineering
20.	Dr.B.Diwan, Associate Professor of Computer Science and Engineering
21.	Dr.Jesline, Associate Professor of Computer Science and Engineering
22.	Dr.A.Sheryl Oliver, Associate Professor of Computer Science and Engineering
23.	Dr.M.Anuradha, Associate Professor of Computer Science and Engineering
24.	Dr.J.Jean Justus, Associate Professor of Computer Science and Engineering
25.	Dr.V.Anjana Devi, Associate Professor of Computer Science and Engineering
26.	Dr.J.Ramya, Associate Professor of Computer Science and Engineering
27.	Dr.N.Angel, Associate Professor of Computer Science and Engineering
28.	Dr. B. Uma Maheswari, Associate Professor of Computer Science and Engineering
29.	Dr. Muthu Lakshmi V, Associate Professor of Information Technology
30.	Dr. Logeshwari D, Associate Professor of Information Technology
31.	Lathaselvi G, Associate Professor of Information Technology
32.	Dr. Heltin Genitha C, Associate Professor of Information Technology
33.	Dr. Tamizhselvi A, Associate Professor of Information Technology
34.	Dr. Sumathi S, Associate Professor of Information Technology
35.	Dr.Duraimurugan S, Associate Professor of Information Technology
36.	Dr. Raman C J, Associate Professor of Information Technology
37.	Dr. Anbu M, Associate Professor of Information Technology
38.	Dr.N. Mythili, Assistant Professor of Computer Science and Engineering
39.	Ms.M.Shalini, Assistant Professor of Computer Science and Engineering
40.	Ms.P.N.Jeipratha, Assistant Professor of Computer Science and Engineering
41.	Mr.K.Balaji, Assistant Professor of Computer Science and Engineering
42.	Dr.N.Manikandan, Assistant Professor of Computer Science and Engineering
43.	Dr.A.Prabhu Chakkaravarthy, Assistant Professor of Computer Science and Engineering

Faculty of Computer Science and Engineering and Information Technology	
44.	Mr.P.Varun, Assistant Professor of Computer Science and Engineering
45.	Ms.S.Shanthini, Assistant Professor of Computer Science and Engineering
46.	Mr.P.Naveen, Assistant Professor of Computer Science and Engineering
47.	Mr.R.Ranjith, Assistant Professor of Computer Science and Engineering
48.	Mr.S.Vinu, Assistant Professor of Computer Science and Engineering
49.	Ms.K.Sudha, Assistant Professor of Computer Science and Engineering
50.	Mr.K.Rajaganesh, Assistant Professor of Computer Science and Engineering
51.	Ms.S.Janani, Assistant Professor of Computer Science and Engineering
52.	Ms.Jenif D Souza WS , Assistant Professor of Computer Science and Engineering
53.	Mr.V.Durai Raji, Assistant Professor of Computer Science and Engineering
54.	Dr.Manikandan G Assistant Professor of Information Technology
55.	Janani M, Assistant Professor of Information Technology
56.	Divya J, Assistant Professor of Information Technology
57.	Thilakavathy P, Assistant Professor of Information Technology
58.	Ancy S ,Assistant Professor of Information Technology
59.	Raja Mohamed N, Assistant Professor of Information Technology
60.	Thresa Jeniffer J, Assistant Professor of Information Technology
61.	Anitha S, Assistant Professor of Information Technology
62.	Priyadharshini K, Assistant Professor of Information Technology
63.	Kripa Sekaran, Assistant Professor of Information Technology
64.	Poornima M, Assistant Professor of Information Technology
65.	Deepa R ,Assistant Professor of Information Technology
66.	Linnet Princy Justina V, Assistant Professor of Information Technology
67.	Arun Mozhi M, Assistant Professor of Information Technology
68.	Radhakrishnan K R, Assistant Professor of Information Technology
69.	Deepa K, Assistant Professor of Information Technology
70.	Kavitha Devi G, Assistant Professor of Information Technology
71.	Stephy S, Assistant Professor of Information Technology
72.	Rini Sarah J, Assistant Professor of Information Technology
73.	Anushya S, Assistant Professor of Information Technology
74.	Gunajothi S, Assistant Professor of Information Technology
75.	Thilagavathi P, Assistant Professor of Information Technology
Special Invitees	
76.	**The Principal,** St. Joseph's College of Engineering, OMR, Chennai – 600 119.
77.	**The Controller of Examinations,** St. Joseph's College of Engineering, OMR, Chennai – 600 119.

Minutes of the Second Board of Studies
Minutes:

BOS 02. 01 **WELCOME ADDRESS AND BRIEF INTRODUCTION OF THE MEMBERS OF BOARD OF STUDIES**

The Second Board of studies meeting of Faculty of Computer Science and Engineering and Information Technology was commenced with welcome address by the Faculty Head. It was followed by brief introduction of members of Board of studies namely University Representative, Subject Experts, Industrial Expert and Alumnus and Internal Faculty Members.

BOS 02. 02 **BRIEF REPORT ON THE PROGRESS OF THE DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING AND INFORMATION TECHNOLOGY**

The Faculty Head has made a brief presentation to the members of the Board of Studies, highlighting the Academic Progress of the Departments Computer Science and Engineering and Information Technology.

BOS 02. 03 **TO CONSIDER AND APPROVE THE CURRICULA AND SYLLABI FROM III TO VIII SEMESTERS OF UG PROGRAMS UNDER THE FACULTY OF COMPUTER SCIENCE AND ENGINEERING AND INFORMATION TECHNOLOGY TO BE OFFERED IN AUTONOMOUS INSTITUTION UNDER R-2021 WITH EFFECT FROM THE ACADEMIC YEAR 2021-2022 ONWARDS.**

RESOLVED TO APPROVE the curricula and syllabi from III to VIII semesters for the following UG programmes under the faculty of Computer Science and Engineering and Information Technology to be, offered in the Autonomous Institution under R-2021 with effect from the Academic Year 2021-2022 onwards by incorporating the following suggestions of the Experts.

i. Rename the subject DS1304 – Foundations to Data Science as DS1304 - Foundations of Data Science.
ii. Rearrange the contents of Unit-I and II in the subject CS1403-Database Design and Management (Lab Integrated).

iii. Reframe the syllabus CS1502 - Object Oriented Analysis and Design with reference to the book “Carol Britton, Jill Doake- A Student Guide to Object oriented Development”.

iv. Additional topic- “Google Homes in IoT” to be included in the subject CS1704- Internet of Things.

v. Professional Elective IT1512 – Human Rights may be excluded.

THE APPROVED CURRICULA AND SYLLABI OF THE FACULTY OF COMPUTER SCIENCE AND ENGINEERING AND INFORMATION TECHNOLOGY (UG PROGRAMS R-2021) ARE GIVEN BELOW:

i. B.E. Computer Science and Engineering
ii. B.Tech. Artificial Intelligence and Data Science
iii. B.Tech. Artificial Intelligence and Machine Learning
iv. B. Tech. Information Technology

BOS 02. 04 Vote of Thanks

The meeting came to end, with the Vote of Thanks proposed by the Faculty Head to all the external and internal members for having spared their time and participated in the Second Board of Studies of Faculty of Computer Science and Engineering and Information Technology, St. Joseph’s College of Engineering, Chennai - 119.

Chairman **Dr. A.Chandra Sekar**, Professor and Head, Faculty of Computer Science and Engineering, and Information Technology, St. Joseph's College of Engineering, OMR, Chennai – 119.	**University Nominee** **Dr. J. C. Miraclin Joyce Pamila**, Professor and Head, Department of Computer Science and Engineering, Government College of Technology, Coimbatore - 641013.	**Subject Expert** **Dr. Krishna Moorthy Sivalingam**, Professor, Department of Computer Science and Engineering, Indian Institute of Technology (IIT) Madras, Chennai – 600036.
Subject Expert **Dr. G. Zayaraz**, Professor & Head, Department of Computer Science and Engineering, Puducherry Technological University Puducherry – 605 014.	**Industrial Expert** **Mr. Abdul Muthalif**, Director Cognizant, Chennai.	**Post Graduate Meritorious Alumnus** **Ms. S.Ram Lakshmi**, Specialist Programmer Infosys, Techno Park, SEZ, Mahindra World City, Paranur, Chennai.