R.M.D. ENGINEERING COLLEGE
(An Autonomous Institution)
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

PEOI: Work effectively in inter-disciplinary field with the knowledge of Artificial Intelligence and Machine Learning to develop appropriate solutions to real-world problems.

PEO2: Excel in professional career and pursue higher education in the field of Artificial Intelligence and Machine Learning.

PEO3: Apply their knowledge to the technological revolution through life-long learning.

PEO4: Excel as socially committed engineers or entrepreneurs with high ethical and moral values.

II. PROGRAM OUTCOMES (POs)

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

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

3 **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.

4 **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.

5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, andmodern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6 **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.

7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and needfor sustainable development.

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

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

10 **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.

11 **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.

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

III. PROGRAM SPECIFIC OUTCOMES (PSOs)

The Students will be able to

PSO1: Apply fundamental concepts of Artificial Intelligence and Data Science to solve technical problems.

PSO2: Utilize Artificial Intelligence and Data Science tools to provide innovative business solutions.

PSO3: Implement the domain knowledge to achieve successful career as an employee, entrepreneur and an engineering professional.

R.M.D. ENGINEERING COLLEGE
(An Autonomous Institution)
REGULATIONS 2021

B.Tech. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
CHOICE BASED CREDIT SYSTEM
CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII
SEMESTER I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21EL101	Communicative English and Life Skills	HS	2	2	0	0	2
2.	21MA101	Engineering Mathematics -I	BS	5	3	2	0	4
3.	21PH104	Engineering Physics	BS	3	3	0	0	3
4.	21CH101	Engineering Chemistry	BS	3	3	0	0	3
5.	21GE101	Problem Solving and C Programming	ES	3	3	0	0	3
6.	21GE103	Basic Electrical, Electronics and Measurement Engineering	ES	3	3	0	0	3
		Induction Program	MC	3 Weeks	-	-	-	-
PRACTICALS								
7.	21PC112	Physics and Chemistry Laboratory	BS	4	0	0	4	2
8.	21GE111	C Programming Laboratory	ES	4	0	0	4	2
9.	21EL111	Interpersonal Skills - Listening and Speaking Laboratory	HS	2	0	0	2	1
TOTAL				**29**	**17**	**2**	**10**	**23**

SEMESTER II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21EL201	Technical English	HS	2	2	0	0	2
2.	21MA201	Engineering Mathematics - II	BS	5	3	2	0	4
3.	21CH102	Environmental Science and Engineering	HS	3	3	0	0	3
4.	21GE105	Computer Aided Engineering Graphics	ES	6	2	0	4	4
5.	21CS201	Data Structures	PC	3	3	0	0	3
6.	21CS202	Python Programming (Lab Integrated)	ES	5	3	0	2	4
PRACTICALS								
7.	21GE211	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	21CS211	Data Structures Laboratory	PC	4	0	0	4	2
9.	21EL211	Advanced Reading and Writing Laboratory	HS	2	0	0	2	1
TOTAL				**34**	**16**	**2**	**16**	**25**

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA301	Probability and Statistics	BS	5	3	2	0	4
2.	21AM301	Digital Principles and Computer Architecture	PC	3	3	0	0	3
3.	21AM302	Principles of Artificial Intelligence (Lab Integrated)	PC	5	3	0	2	4
4.	21CS302	Object Oriented Programming	PC	3	3	0	0	3
5.	21IT403	Database Management Systems	PC	3	3	0	0	3
6.	21GE301	Universal Human Values II: Understanding Harmony	HS	4	2	2	0	3
PRACTICALS								
7.	21CS311	Object Oriented Programming Laboratory	PC	4	0	0	4	2
8.	21IT412	Database Management Systems Laboratory	PC	4	0	0	4	2
9.	21AM311	Mini Project	EEC	2	0	0	2	1
10.	21CS313	Aptitude and Coding Skills - I	EEC	2	0	0	2	1
TOTAL				**35**	**17**	**4**	**14**	**26**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA402	Linear Algebra	BS	5	3	2	0	4
2.	21AM401	Machine Learning Essentials	PC	3	3	0	0	3
3.	21AM402	Data Analytics	PC	3	3	0	0	3
4.	21AM403	Object Oriented Software Engineering	PC	3	3	0	0	3
5.	21AM404	Operating System Fundamentals (Lab Integrated)	PC	5	3	0	2	4
6.	21CS402	Design and Analysis of Algorithms	PC	4	2	2	0	3
PRACTICALS								
7.	21AM411	Machine Learning Laboratory	PC	4	0	0	4	2
8.	21AM412	Data Analytics Laboratory	PC	4	0	0	4	2
9.	21AM413	Internship	EEC	-	-	-	-	1
10.	21CS414	Aptitude and Coding Skills – II	EEC	2	0	0	2	1
TOTAL				**33**	**17**	**4**	**12**	**26**

SEMESTER V

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21MA302	Discrete Mathematics	BS	5	3	2	0	4
2.	21AM501	Neural Networks	PC	3	3	0	0	3
3.	21AM502	Data Visualization(Lab Integrated)	PC	5	3	0	2	4
4.		Open Elective - I*	OE	3	3	0	0	3
5.		Professional Elective - I	PE	3	3	0	0	3
PRACTICALS								
6.	21AM511	Neural Networks Laboratory	PC	4	0	0	4	2
7.	21CS513	Mini Project and Design Thinking Practices Laboratory	EEC	2	0	0	2	1
8.	21CS514	Advanced Aptitude and Coding Skills – I	EEC	2	0	0	2	1
TOTAL				**27**	**15**	**2**	**10**	**21**

***Course from the curriculum of other UG programmes**

SEMESTER VI

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21AM601	Principles and Practices in Deep Learning (Lab integrated)	PC	5	3	0	2	4
2.	21AM602	Pattern Recognition	PC	3	3	0	0	3
3.		Professional Elective - II	PE	3	3	0	0	3
4.		Professional Elective - III	PE	3	3	0	0	3
PRACTICALS								
5.	21AM613	Internship and Career Readineess Course	EEC	2	0	0	2	1
6.	21CS614	Advanced Aptitude and Coding Skills – II	EEC	2	0	0	2	1
TOTAL				**18**	**12**	**0**	**6**	**15**

SEMESTER VII

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21AM701	Natural Language Processing (Lab Integrated)	PC	5	3	0	2	4
2.	21AM702	Computer Vision	PC	3	3	0	0	3
3.		Open Elective - II*	OE	3	3	0	0	3
4.		Professional Elective - IV	PE	3	3	0	0	3
5.		Professional Elective - V	PE	3	3	0	0	3
6.		Professional Elective - VI	PE	3	3	0	0	3
TOTAL				**20**	**18**	**0**	**2**	**19**

***Course from the curriculum of other UG programmes**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	21AM811	Project Work	EEC	16	0	0	16	8
TOTAL				**16**	**0**	**0**	**16**	**8**

TOTAL NO. OF CREDITS: 163

HUMANITIES AND SOCIAL SCIENCES (HS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21EL101	Communicative English and Life Skills	HS	2	2	0	0	2
2.	21EL111	Interpersonal Skills - Listening and Speaking Laboratory	HS	2	0	0	2	1
3.	21EL201	Technical English	HS	2	2	0	0	2
4.	21EL211	Advanced Reading and Writing laboratory	HS	2	0	0	2	1
5.	21CH102	Environmental Science and Engineering	HS	3	3	0	0	3
6.	21GE301	Universal Human Values II: Understanding Harmony	HS	4	2	2	0	3

BASIC SCIENCES (BS)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21MA101	Engineering Mathematics - I	BS	5	3	2	0	4
2.	21PH104	Engineering Physics	BS	3	3	0	0	3
3.	21CH101	Engineering Chemistry	BS	3	3	0	0	3
4.	21PC112	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	21MA201	Engineering Mathematics - II	BS	5	3	2	0	4
6.	21MA301	Probability and Statistics	BS	5	3	2	0	4
7.	21MA402	Linear Algebra	BS	5	3	2	0	4
8.	21MA501	Discrete Mathematics	BS	5	3	2	0	4

MANDATORY COURSE (MC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.		Induction Program	MC	3 Weeks	-	-	-	-

ENGINEERING SCIENCES (ES)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21GE101	Problem Solving and C Programming	ES	3	3	0	0	3
2.	21GE103	Basic Electrical Electronics and Measurement Engineering	ES	3	3	0	0	3
3.	21GE111	C Programming Laboratory	ES	4	0	0	4	2
4.	21GE105	Computer Aided Engineering Graphics	ES	6	2	0	4	4
5.	21CS202	Python Programming (Lab Integrated)	ES	5	3	0	2	4
6.	21GE211	Engineering Practices Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21AM301	Digital Principles and Computer Architecture	PC	3	3	0	0	3
2.	21AM302	Principles of Artificial Intelligence(Lab Integrated)	PC	5	3	0	2	4
3.	21AM401	Machine Learning Essentials	PC	3	3	0	0	3
4.	21AM402	Data Analytics	PC	3	3	0	0	3
5.	21AM403	Object Oriented Software Engineering	PC	3	3	0	0	3
6.	21AM404	Operating System Fundamentals (Lab Integrated)	PC	5	3	0	2	4
7.	21AM411	Machine Learning Laboratory	PC	4	0	0	4	2
8.	21AM412	Data Analytics Laboratory	PC	4	0	0	4	2
9.	21AM501	Neural Networks	PC	3	3	0	0	3
10.	21AM502	Data Visualization(Lab Integrated)	PC	5	3	2	0	4
11.	21AM511	Neural Networks Laboratory	PC	4	0	0	4	2

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
12.	21AM601	Principles and Practices inDeep Learning (Lab Integrated)	PC	5	3	2	0	4
13.	21AM602	Pattern Recognition	PC	3	3	0	0	3
14.	21AM701	Natural Language Processing (Lab Integrated)	PC	5	3	0	2	4
15.	21AM702	Computer Vision	PC	3	3	0	0	3
16.	21CS201	Data Structures	PC	3	3	0	0	3
17.	21CS211	Data Structures Laboratory	PC	4	0	0	4	2
18.	21CS302	Object Oriented Programming	PC	3	3	0	0	3
19.	21CS311	Object Oriented Programming Laboratory	PC	4	0	0	4	2
20.	21CS402	Design and Analysis ofAlgorithms	PC	4	2	2	0	3
21.	21IT403	Database ManagementSystems	PC	3	3	0	0	3
22.	21IT412	Database ManagementSystems Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

SEMESTER V/VI – PROFESSIONAL ELECTIVE – I / II /III

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21AM901	Quantum Machine Learning	PE	3	3	0	0	3
2.	21AM902	Nature Inspired Computing Techniques	PE	3	3	0	0	3
3.	21AM903	Reinforcement Learning	PE	3	3	0	0	3
4.	21AM904	Speech Processing	PE	3	3	0	0	3
5.	21AM905	Information Extraction and Retrieval	PE	3	3	0	0	3
6.	21AM906	Statistical Learning Theory	PE	3	3	0	0	3
7.	21AM907	AI in Blockchain	PE	3	3	0	0	3
8.	21AM908	Knowledge Engineering	PE	3	3	0	0	3

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
9.	21AM909	Applications of AI in Healthcare	PE	3	3	0	0	3
10.	21AM910	Automata Theory and Compiler Design	PE	3	3	0	0	3
11.	21CS901	Cyber Physical Systems	PE	3	3	0	0	3
12.	21CS904	Image Processing	PE	3	3	0	0	3
13.	21CS911	High Performance Computing	PE	3	3	0	0	3
14.	21CS912	Multi-core Architecture and Programming	PE	3	3	0	0	3
15.	21CS913	Internet of Things	PE	3	3	0	0	3
16.	21CS501	Computer Networks	PE	4	2	0	2	3
17.	21CS917	Data Science Fundamentals	PE	3	3	0	0	3
18.	21CS929	Google Cloud Computing Foundation	PE	3	3	0	0	3
19.	21CS924	Game Theory andProgramming	PE	3	3	0	0	3
20.	21CS403	Internet Programming	PE	3	3	0	0	3
21.	21CS602	Cryptography and Network Security	PE	3	3	0	0	3
22.	21IT917	Essence of Indian Traditional Knowledge	PE	3	3	0	0	3
23.	21CS937	Principles of Management	PE	3	3	0	0	3

SEMESTER VII – PROFESSIONAL ELECTIVE – IV / V /VI

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21AM912	Rough Sets and Fuzzy Systems	PE	3	3	0	0	3
2.	21AM913	Semantic Web	PE	3	3	0	0	3
3.	21AM914	Soft Computing	PE	3	3	0	0	3
4.	21AM915	AI in Cyber Security	PE	3	3	0	0	3
5.	21AM916	Optimization Methods in MachineLearning	PE	3	3	0	0	3
6.	21AM917	Image and Video Analytics	PE	3	3	0	0	3
7.	21AM918	Cognitive Science and Analytics	PE	3	3	0	0	3

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
8.	21AM919	Intelligent Agent Technology	PE	3	3	0	0	3
9.	21AM920	Machine Learning for Bioinformatics	PE	3	3	0	0	3
10.	21AM921	Computational Intelligence	PE	3	3	0	0	3
11.	21AM922	Data and InformationSecurity	PE	3	3	0	0	3
12.	21AM923	Augmented Realityand Virtual Reality	PE	3	3	0	0	3
13.	21CS903	Vulnerability Analysis and Penetration Testing	PE	3	3	0	0	3
14.	21CS906	Software Project Management	PE	3	3	0	0	3
15.	21CS907	Human Computer Interaction	PE	3	3	0	0	3
16.	21CS910	Social Network Analysis	PE	3	3	0	0	3
17.	21CS936	Professional Ethics in Engineering	PE	3	3	0	0	3
18.	21CS919	Cyber Forensics	PE	3	3	0	0	3
19.	21CS921	Quantum Computing	PE	3	3	0	0	3
20.	21CS923	Resource Management Techniques	PE	3	3	0	0	3
21.	21CS927	UI/UX Design	PE	4	2	0	2	3
22.	21CS930	Lean Six Sigma	PE	3	3	0	0	3
23.	21IT927	Indian Constitution	PE	3	3	0	0	3
24.	21IT711	Professional Readiness for Innovation, Employability and Entrepreneurship	PE	6	0	0	6	3
25.	21AM911	Distributed and Cloud Computing	PE	3	2	0	2	3
26.	21CS918	Google Cloud: Architecting with Google Compute Engine	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	21AM311	Mini Project	EEC	2	0	0	2	1
2.	21CS314	Aptitude and Coding Skills – I	EEC	2	0	0	2	1
3.	21AM413	Internship	EEC	-	-	-	-	1
4.	21CS414	Aptitude and Coding Skills – II	EEC	2	0	0	2	1
5.	21CS512	Advanced Aptitude and Coding Skills – I	EEC	2	0	0	2	1
6.	21CS513	Mini Project and Design Thinking Practices Lab	EEC	2	0	0	2	1
7.	21AM613	Internship and Career Readiness Course	EEC	2	0	0	2	1
8.	21CS614	Advanced Aptitude and Coding Skills – II	EEC	2	0	0	2	1
9.	21AM811	Project Work	EEC	16	0	0	16	8
TOTAL				**28**	**0**	**0**	**28**	**16**

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								TOTAL CREDITS	PERCENTAGE
		I	II	III	IV	V	VI	VII	VIII		
1.	**HS**	3	6	3						**12**	7.36%
2.	**BS**	12	4	4	4	4				**28**	17.17%
3.	**ES**	8	10							**18**	11.04%
4.	**PC**		5	17	20	9	7	7		**65**	39.88%
5.	**PE**					3	6	9		**18**	11.04%
6.	**OE**					3		3		**6**	3.68%
7.	**EEC**			2	2	2	2		8	**16**	9.82%
8.	**MC**										
TOTAL		**23**	**25**	**26**	**26**	**21**	**15**	**19**	**8**	**163**	

HUMANITIES AND SOCIAL SCIENCES (HS) / BASIC SCIENCES (BS) / ENGINEERING SCIENCES (ES) / PROFESSIONAL CORE (PC) / PROFESSIONAL ELECTIVES (PE) / OPEN ELECTIVES (OE)/EMPLOYABILITY ENHANCEMENT COURSES (EEC) / MANDATORY COURSES (MC)

CURRICULUM OF
B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING WITH SPECIALIZATION IN APPLICATIONS OF AI

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	21AM907	AI in Blockchain	PE	3	3	0	0	3
2.	21AM909	Applications of AI in Healthcare	PE	3	3	0	0	3
3.	21AM917	Image and Video Analytics	PE	3	3	0	0	3
4.	21AM915	AI in Cyber Security	PE	3	3	0	0	3
5.	21AM924	Capstone Project	EEC	12	0	0	12	6
Total				**24**	**12**	**0**	**12**	**18**

CURRICULUM OF
B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Additional 18 credits to be completed from the courses offered in the Professional Elective Pool I/II/III/IV/V/VI

MINOR DEGREE CURRICULUM OFFERED BY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(for other B.E. / B.Tech. Programmes)

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE

Sl.No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	21AM925	Introduction to Data Science (Lab Integrated)	4	2	0	2	3
2.	21AM926	Artificial Intelligence	3	3	0	0	3
3.	21AM927	Data Exploration and Visualization	3	3	0	0	3
4.	21AM928	Machine Learning Algorithms	3	3	0	0	3
5.	21AM929	Foundations of Deep Learning	3	3	0	0	3
6.	21AM930	Natural Language Processing	3	3	0	0	3
7.	21AM931	Capstone Project	12	0	0	12	6

MINOR DEGREE OFFERED TO THE STUDENTS OF
B.TECH. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

MINOR DEGREE IN INTERNET OF THINGS

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	21EC901	Introduction to Internet of Things	PE	3	3	0	0	3
2	21EC902	Sensors and Actuator Devices	PE	3	3	0	0	3
3	21EC903	Image and Video Analytics	PE	3	3	0	0	3
4	21EC904	Robot Operating Systems	PE	3	3	0	0	3
5	21EC905	Capstone project	PE	12	0	0	12	6

SEMESTER I

21EL101 COMMUNICATIVE ENGLISH AND LIFE SKILLS

L	T	P	C
2	0	0	2

OBJECTIVES:

The Course will enable learners to:

- Strengthen their basic reading and writing skills.
- Comprehend listening contexts competently.
- Improve their speaking skills to speak fluently in real contexts.
- Develop vocabulary of a general kind and enhance their grammatical accuracy.

UNIT I COMMUNICATION BASICS **6**

Listening - short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information. Reading - practice in skimming - scanning and predicting. Writing-completing sentences - developing hints- free writing – Everyday expressions- collocations. Life Skills - Overview of Life Skills: significance of life skills.

UNIT II COMMUNICATION INTERMEDIATE **6**

Listening- telephonic conversations. Speaking – sharing information of a personal kind - greeting – taking leave. Reading – short comprehension passages - pre-reading-post reading-comprehension questions (multiple choice questions and /or short questions / open-ended questions) - Writing – paragraph writing- topic sentence - main ideas, short narrative descriptions using some suggested vocabulary and structures. Life skills – Self-awareness: definition, need for self-awareness; Coping with Stress and Emotions.

UNIT III COMMUNICATION VANTAGE **6**

Listening – listening to longer texts and filling up the table - Speaking- asking about routine actions and expressing opinions. Reading- Long texts (cloze reading) - Writing- jumbled sentences - product description - use of reference words and discourse markers. Grammar – Tenses - phrasal verbs - Wh – Questions, yes or no questions and direct / indirect questions – countable & uncountable nouns – modal verbs. Life skills – Assertiveness vs Aggressiveness

UNIT IV SYNERGISTIC COMMUNICATION **6**

Listening - listening to dialogues or conversations and completing exercises based on them - Speaking- speaking about oneself- speaking about one's friend – Reading - different types of

texts- magazines - Writing - letter writing, informal or personal letters - e-mails-conventions of personal email - Language development - synonyms – antonyms. Life Skills –Problem Solving Techniques.

UNIT V COMMUNICATION HIGHER 6

Listening – listening to TED talks - Speaking – role play – Reading - Biographies – Writing- writing short essays (analytical & issue-based essays) – dialogue writing. Life Skills – Leadership & Decision making.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Read articles of a general kind in magazines and newspapers efficiently and identify different life skills.
- Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques to cope with emotions and stress.
- Comprehend conversations and short talks delivered in English.
- Write short essays of a general kind and personal letters and emails in English.
- Develop vocabulary of a general kind by enriching their reading skills.
- Use appropriate thinking and problem- solving techniques to solve new problems.

TEXT BOOKS:

1. Kumar, Suresh E and Sreehari, P. Communicative English. Orient Black Swan, 2007.
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP,2015.

REFERENCES:

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.
3. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
4. Larry James, The First Book of Life Skills; First Edition, Embassy Books, 2016.
5. Larsen, Kristine, Stephen Hawking: A Biography, Greenwood: Publishing Group,2005.
6. Redston, Chris &Gillies Cunningham Face2Face (Pre-intermediate Student 's Book & Workbook) Cambridge University Press, New Delhi: 2005.

21MA101	ENGINEERING MATHEMATICS – I	L	T	P	C
		3	2	0	4

OBJECTIVES:

The syllabus is designed to:

- Explain the concepts of matrix algebra.
- Make the students understand the idea of curvature, evolutes and envelopes.
- Impart the knowledge of functions of several variables.
- Introduce the concepts of Gamma and Beta integral.
- Develop an understanding on the basics of multiple integrals.

UNIT I MATRICES 9+6

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II APPLICATIONS OF DIFFERENTIAL CALCULUS 9+6

Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes (excluding Evolute as envelope of normals).

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+6

Limits – Continuity – Partial derivatives (excluding Euler's theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV GAMMA, BETA INTEGRALS AND APPLICATIONS 9+6

Gamma and Beta Integrals – Properties – Relation between Gamma and Beta functions, Evaluation of integrals using Gamma and Beta functions.

UNIT V MULTIPLE INTEGRALS 9+6

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids.

TOTAL: 75 PERIODS

OUTCOMES:

After the successful completion of the course, the student will be able to:

- Diagonalize a matrix by orthogonal transformation.
- Determine the Evolute and Envelope of curves.
- Examine the maxima and minima of function of several variables.
- Apply Gamma and Beta integrals to evaluate improper integrals.
- Evaluate the area and volume by using multiple integrals.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
3. T. Veerarajan, "Engineering Mathematics", Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

REFERENCES:

1. M. K. Venkataraman, “Engineering Mathematics, Volume I”, 4th Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, “Engineering Mathematics”, Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, “Higher Engineering Mathematics”, S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, “Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

21PH104	ENGINEERING PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable the learners to:

- Learn the fundamental concepts of Mechanics and apply this knowledge to solve thescientific, engineering and technological problems.
- Get exposure and learn the basics of Quantum Mechanics concepts and itsapplications in the working of Nano Devices and Quantum Computing.

UNIT I MECHANICS **8**

Moment of inertia (M.I) - Radius of gyration - Theorems of M.I - M.I of circular disc, solid cylinder, hollowcylinder, solid sphere and hollow sphere - K.E of a rotating body – M.I of a diatomic molecule– Rotationalenergy state of a rigid diatomic molecule - centre of mass – conservation of linear momentum – Relation between Torque and angular momentum – Torsional pendulum – linear and nonlinear oscillations: simple pendulum and double pendulum.

UNIT II WAVES AND ELECTROMAGNETISM **10**

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves – Energy transfer of a wave - sound waves – ultrasonic waves. The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization – Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III BASIC QUANTUM MECHANICS **9**

Photons and light waves - Electrons and matter waves - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization – Free particle - Particle in a one-dimensional box (infinite potential well) - Normalization, probabilities and the correspondence principle – wave packets.

UNIT IV APPLIED QUANTUM MECHANICS **9**

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope - Finite potential wells - particle in a two and three dimensional box - Bloch’s theorem for particles in a periodic potential - Kronig-Penney model and origin of energy bands and importance of energy band gap.

UNIT V NANODEVICES AND QUANTUM COMPUTING **9**

Introduction - quantum confinement – quantum structures: quantum wells, wires and dots — band gap ofnanomaterials. Tunneling – Single electron phenomena: Coulomb blockade - resonant- tunneling diode – single electron transistor. Quantum system for information processing - quantumstates – classical bits – quantum bits or qubits – multiple qubits – Bloch sphere – quantum gates –advantage of quantumcomputing over classical computing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the fundamental concepts of Mechanics to calculate the Moment of Inertiaof both regular and irregular bodies.
- Understand the wide range of applications of electromagnetic principles includingthe working of cell phone.
- Gain knowledge on the basics of Quantum Mechanics.
- Analyze the Quantum concepts to apply in the working of Tunneling Microscopes.
- Appreciate the advanced Quantum Concepts like Kronig Penny Model and Bloch'stheorem.
- Evaluate the Quantum concepts to apply in Nano Devices, Quantum computingand data storage.

TEXT BOOKS:

1. D. Kleppner and R. Kolenkow, An Introduction to Mechanics, McGraw HillEducation, 2017.
2. D. Halliday, R. Resnick and J. Walker, Principles of Physics, John Wiley & Sons,2015.
3. N. Garcia, A. Damask and S. Schwarz, Physics for Computer Science Students,Springer - Verlag, 2012.
4. Paul A. Tipler and R. A. Llewellyn, Modern Physics, W. H. Freeman and Co.,2012.
5. S. Mani Naidu, Engineering Physics-II for JNTUK, Pearson, 2012.
6. P. M. Mathews and K. Venkatesan, A text book of Quantum Mechanics, SecondEdition, McGraw Hill Education, 2010.
7. Satya Prakash, Advanced Quantum Mechanics, Kedar Nath & Ram Nath, 2012.

REFERENCES:

1. R. Wolfson, Essential University Physics, Volume 1 & 2, Pearson, 2020.
2. Neil Gershenfeld, The Physics of Information Technology, Cambridge Univ.Press, 2000.
3. S. Rajasekar and R. Velusamy, Quantum mechanics – I & II, CRC Press, 2015.
4. P. Tandon, S. Lam, B. Shih, T. Mehta, A. Mitev and Z. Ong, Quantum robotics,Morgan & Claypool Publishers, 2017.
5. Ben Rogers, J. Adams and S. Pennathur, Nanotechnology: Understanding smallsystems, CRC Press, 2015.

21CH101 **ENGINEERING CHEMISTRY**

L	T	P	C
3	0	0	3

OBJECTIVES:

The goal of this course is to achieve conceptual understanding of the applications of chemistry in engineering and technology. The syllabus is designed to:

- Understand the role of chemistry in everyday life.
- Develop an understanding of the basic concepts of electro chemistry and its applications.
- Learn the principles and generation of energy in different types of batteries, fuel cells, nuclear reactors, solar cells and wind mills.
- Make them acquire basic knowledge of polymers, their classification and the applications of speciality polymers in engineering and technology.
- Understand the preparation, properties and applications of nanomaterials in various fields.

UNIT I CHEMISTRY IN EVERYDAY LIFE 8

Importance of chemistry in everyday life- food additives - types (colours, preservatives, flavoursand sweeteners), effects - food adulteration – types of adulteration (intentional, incidental) - effects offood adulterants – cosmetics and personal care products (fairness creams, perfumes, deodorants, shampoos)- effects – beverages-classification – carbonated beverages – nutritive values and effects.

Water – impurities – industrial uses of water – hardness, external treatment (demineralization) – desalination (reverse osmosis).

UNIT II ELECTROCHEMISTRY 10

Introduction – terminology - conductance of electrolytes- specific conductance, equivalent conductance, molar conductance- factors affecting conductance- origin of electrode potential-singleelectrode potential, standard electrode potential- measurement of single electrode potential-referenceelectrodes (standard hydrogen electrode, calomel electrode) - electrochemical series, applications –measurement of EMF of the cell – Nernst equation (derivation), numerical problems.

Chemical sensors – principle of chemical sensors- breath analyzer and Clark oxygen analyzer.

UNIT III ENERGY STORAGE DEVICES AND ENERGY SOURCES 9

Batteries – primary battery (alkaline battery) - secondary battery (Pb-acid battery, Ni-metal hydride battery, Li-ion battery) - fuel cells (H2-O2 fuel cell).

Nuclear Energy –nuclear reactions – fission, fusion, differences, characteristics– nuclear chain reactions –light water nuclear reactor – breeder reactor.

Renewable energy sources- solar energy – thermal conversion (solar water heater and heat collector) - photovoltaic cell– wind energy.

UNIT IV POLYMERS 9

Introduction – monomer, functionality, degree of polymerization – classification based on sources and applications – effect of polymer structure on properties - types of polymerization (addition, condensation) - thermoplastic and thermosetting resins – preparation, properties and applications of Teflon, polyvinyl chloride, polycarbonate, Bakelite.

Special polymers - biodegradable polymers - properties and applications of polycaprolactone, polyhydroxyalkanoate – properties and applications of electrically conducting polymers (poly aniline, polyvinylidene fluoride).

UNIT V NANOCHEMISTRY 9

Introduction – synthesis – top-down process (laser ablation, chemical vapour deposition), bottom-up process (precipitation, electrochemical deposition) – properties of nanomaterials – types (nanorods, nanowires, nanotubes-carbon nanotubes, nanocomposites).

Applicationsof carbon nanotubes – applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Illustrate the role of chemistry in everyday life and the industrial uses of water.
- Construct electrochemical cells and to determine the cell potential.
- Compare and analyse the different energy storage devices and to explain potential energy sources.
- Classify different types of polymeric materials and to discuss their properties and applications.
- Explain basic concepts of nanochemistry and to enumerate the applications of nanomaterials in engineering and technology.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2018.
2. Prasanta Rath, "Engineering Chemistry", 1st edition, Cengage Learning India Pvt. Ltd., Delhi, 2015.

REFERENCES:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", 12th edition, S. Chand & Company, New Delhi, 2010.
2. Kirpal Singh, "Chemistry in daily life", 3rd edition, PHI Learning Pvt. Ltd., 2012.
3. J. C. Kuriacose and J. Rajaram, "Chemistry in Engineering and Technology", Volume-1 & Volume -2, Tata McGraw-Hill Education Pvt. Ltd., 2010.
4. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, "Nanochemistry: A Chemical Approach to Nanomaterials", 2nd edition, RSC publishers, 2015.
5. Prasanna Chandrasekhar, "Conducting polymers, fundamentals and applications - A Practical Approach", 1st edition, Springer Science &Business Media, New York, 1999.

21GE101	PROBLEM SOLVING AND C PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To make the students understand the fundamentals of problem solving using Algorithm and Flowchart.
- To teach the basic programming constructs for solving simple problems.
- To introduce the basic concepts of arrays and strings.
- To acquaint the students about functions, pointers, structures and their relationship.
- To impart knowledge on the concepts of file handling.

UNIT I INTRODUCTION TO ALGORITHM AND C **9**

Introduction to Computer System – Block diagram, Program Development Life Cycle

General problem Solving concepts: Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

Imperative languages: Introduction to imperative language, syntax and constructs of a specific language (ANSI C), Applications

Types, Operators: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Basic I/O using scanf, printf, Operators – Types, Precedence, Associativity,Proper variable naming and Hungarian Notation.

UNIT II CONTROL FLOW STATEMENTS **7**

Control Flow with discussion on structured and unstructured programming: Statements and Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, goto labels, structured and unstructured programming.

UNIT III ARRAYS AND FUNCTIONS 10

Arrays and Strings – Initialization, Declaration – One Dimensional and Two Dimensional arrays – Linear search, Binary Search, Matrix Operations (Addition and Subtraction)

Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialisation, Recursion, Pre-processor, Standard Library Functions and return types.

UNIT IV STRUCTURES AND POINTERS 10

Basic Structures, Structures and Functions, Array of structures.

Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

Pointer of structures, Self-referential structures, Table look up, typedef, unions, Bit-fields

UNIT V FORMATTED I/O AND FILE PROCESSING 9

Formatted Output – fprintf, Formated Input – fscanf, Variable length argument list

Files - file access including FILE structure, fopen, fread, fwrite, stdin, sdtout and stderr, File Types – Text, Binary - Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Develop algorithmic solutions to simple computational problems
- Develop simple applications using basic constructs
- Write programs using arrays and strings
- Design and implement applications using functions, pointers and structures.
- Design applications using sequential and random access file processing.

TEXT BOOKS:

1. Brian W Kernighan and Dennis M Ritchie, The C Programming Language, Pearson Education India, 2nd Edition, 2015.
2. Anita Goel and Ajay Mittal, “Computer Fundamentals and Programming in C”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

REFERENCES:

1. B. Gottfried, Programming with C, Schaum Outline Series, Fourth Edition, 2018
2. Herbert Schildt, C: The Complete Reference, McGraw Hill, Fourth Edition, 2017
3. Yashavant Kanetkar, Let Us C, BPB Publications, 16th Edition, 2018.
4. Reema Thareja, “Programming in C”, 2nd Edition, Oxford University Press, 2018.
5. Zed A. Shaw, “Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (like C)”, (Zed Shaw’s Hard Way Series), 1st Edition, Addison-Wesley Professional, 2015.

21GE103	BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The syllabus is designed to:

- To impart knowledge on fundamentals of electrical circuits and its analysis
- To interpret the basic principles of electrical machines and their performance
- To examine the different energy sources and protection methods
- To explore the different types of electronic circuits and its characteristics
- To acquire knowledge on the principles and operation of measuring instruments and transducers

UNIT I ELECTRICAL CIRCUITS ANALYSIS 9

Ohms Law, Kirchhoff‘s Law- power- series and parallel circuit analysis with resistive, capacitive and inductive network - nodal analysis, mesh analysis- - star delta conversion.

UNIT II POWER SYSTEM 9

Power Generation -Thermal-Hydro-wind and solar. construction and working principle. Protection-need for earthing, fuses and circuit breakers. Energy Tariff calculation for domestic loads.

UNIT III ELECTRICAL MACHINES 9

DC Generator-Types, Construction, working principle, EMF equation, DC Motor- working Principle, - Three Phase Induction Motors- Types, Construction, working principle- Single Phase Induction Motors, –working Principle -Transformers-Types and construction, EMF equation- Basics of Stepper Motor- applications of various machines

UNIT IV ELECTRONIC CIRCUITS 9

PN Junction-VI Characteristics of Diode, Rectifier- zener diode, Transistors OPAMP-configuration, differentiator, integrator, ADC- Types, Successive approximation type, DAC-Types, Weighted resistor DAC and R-2R ladder type, Voltage regulator IC using LM 723, LM 317.

UNIT V ELECTRICAL MEASUREMENT 9

Characteristic of measurement-errors in measurement, torque in indicating instruments- moving coil and moving iron meters, Induction type Energy meter and Dynamometer watt meter. Transducers- classification-Thermocouple, RTD, Strain gauge, LVDT, LDR and piezoelectric. Oscilloscope-CRO.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Analyse the electric circuits.
- Classify the different types of electric machines and transformers
- Study the different type of renewable sources and common domestic loads.
- Acquire knowledge in basics of electronic circuits.
- Describe the different types of measuring instruments and transducers.

TEXT BOOKS:

1. S.K.Bhattacharya, Basic Electrical and Electronics Engineering, Pearson (Covers Units 1,2,4 and 5)
2. C L Wadhwa, Generation Distribution and Utilization of Electrical Energy, New Age International: Unit 3 except Domestic refrigerator and air conditioner - construction and working principle)

REFERENCES:

1. S.B. LalSeksena and Kaustuv Dasgupta, Fundaments of Electrical Engineering, Cambridge, 2016
2. B.L Theraja, Fundamentals of Electrical Engineering and Electronics. Chand & Co
3. S.K.Sahdev, Basic of Electrical Engineering, Pearson
4. John Bird, Electrical and Electronic Principles and Technology‖, Fourth Edition, Elsevier,

5. Mittle,Mittal, Basic Electrical Engineering‖, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. R.S Khurmi and J K Gupta, Textbook of Refrigeration and Air-conditioning (M.E.), S Chand & Co.

21PC112 PHYSICS AND CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

PHYSICS LABORATORY

OBJECTIVES:

- Introduce different experiments to enrich the basic understanding of Physics conceptsapplied to Properties of Matter, Semiconductors, Ultrasonics and Quantum Physics.

LIST OF EXPERIMENTS:(Any five experiments to be conducted)

1. Torsional pendulum - Determination of rigidity modulus of wires (various thickness and lengths)
2. Torsional pendulum – Determination of moment of inertia of a disc and an irregular body.
3. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
4. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of Liquids.
5. Melde's string experiment: Determination of frequency of an electrically vibrating tuning fork.
6. Post office box: Determination of Band gap of asemiconductor.
7. Photoelectric effect: Determination of Planck's constant.
8. Experiments with lattice dynamics kit.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Determine the Moment of Inertia and Rigidity modulus of the material of the wire usingTorsion Pendulum.
- Use the ultrasonic interferometer to determine the wavelength and velocity of ultrasonic wavesof a liquid.
- Calculate the frequency of an electrically vibrating tuningfork. Find out the band gap of a semiconductor.
- Prove the phenomenon of Photoelectric effect and calculate Planck'sconstant.
- Analyze the Lattice dynamics using Lattice Dynamics Kit.

REFERENCES:

1. Department of Physics, R.M.D. Engineering College, Physics laboratory manual, SamrajPrinters, 2021.
2. Wilson J. D. and Hernandez C. A., Physics Laboratory Experiment, HoughtonMifflin Company, New York, 2005.

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the students acquire practical skills through volumetric and instrumentalanalysis.

LIST OF EXPERIMENTS:(Any five experiments to be conducted)

1. Determination of total, temporary and permanent hardness of water by EDTAmethod.
2. Conductometric titration of strong acid vs. strong base.
3. Determination of strength of acids in a mixture using conductivity meter.
4. Determination of strength of given hydrochloric acid using pH meter.
5. Estimation of the iron content of the given solution using potentiometer.
6. Estimation of the iron content of the water sample using spectrophotometer(thiocyanate method).
7. Estimation of sodium present in water using flame photometer.
8. Determination of the molecular weight of polyvinyl alcohol using Ostwaldviscometer.
9. Determination of corrosion rate by weight loss method.
10. Determination of flash and fire point of a lubricating oil (Pensky Martensapparatus).
11. Determination of concentration of a given solution by constructing a galvanic cell.

TOTAL: 30 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Analyze the given hard water sample and estimate different types of hardnesspresent.
- Observe and analyze the change in conductivityof an acid(s) when added with basethrough conductometry.
- Examine the change in pH when an acid is added with a base using pHmeter.
- Understand the redox reactions and its impacts on emf values through
- potentiometry.
- Determine the flash and fire point of anoil.
- Assess the corrosion rate of a given metal.
- Construct an electrochemical cell to determine the concentration of the given solution.

REFERENCES:

1. Dr. K.S. Radha and Dr. S. Rekha, "Chemistry Laboratory Manual", Samraj Printers, Chennai, 2021.
2. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Education Pvt. Ltd. 2009.

20GE111	C PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

The syllabus is designed to:

- To make the students write simple programs using basic constructs
- To familiarize the concepts of strings, pointers, functions and structures
- To equip the students on the knowledge of file processing concepts

LIST OF EXPERIMENTS:

1. Constructing Flow charts using RAPTOR tools.
2. Programs using I/O statements and expression
3. Write a program to find whether the given line is horizontal or vertical.
4. Write a program to calculate the distance between two points p1(x1,y1), p2(x2,y2).
5. Write a program to calculate the force for the given mass and acceleration.
6. Write a program to calculate the Young's modulus.
7. Write a program to calculate the type of solution based on its pH value.
8. Write a program to temperature conversion (Fahrenheit to Celsius and vice versa)
9. Programs using decision-making constructs.
10. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
11. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
12. Check whether a given number is Armstrong number or not?
13. Given a set of numbers like, find sum of weights based on the following conditions.
    - 5 if it is a perfect cube.
    - 4 if it is a multiple of 4 and divisible by 6.
    - 3 if it is a prime number.

    Sort the numbers based on the weight in the increasing order as shown below
    <10,its weight>, <36,its weight>, <89,its weight>
14. Populate an array with height of persons and find how many persons are above the average
    height.
15. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
16. Given a string a$bcd./fg‖ find its reverse without changing the position of special characters.(Example input:a@gh%;j and output:j@hg%;a)
17. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
18. From a given paragraph perform the following using built-in functions:

    a. Find the total number of words.
    b. Capitalize the first word of each sentence.
    c. Replace a given word with another word.
19. Solve towers of Hanoi using recursion.
20. Sort the list of numbers using pass by reference.
21. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:

    EID, Ename, Designation, DOB, DOJ, Basicpay

    Note that DOB and DOJ should be implemented using structure within structure.
22. Compute internal marks of students for five different subjects using structures and functions.
23. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
24. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
25. Mini project: Create a ―Railway reservation system with the following modules
    - Booking
    - Availability checking

- Cancellation
- Prepare chart

TOTAL: 60 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Write programs for simple applications making use of basic constructs, arrays and strings.
- Develop programs involving functions, recursion, pointers, and structures.
- Create applications using sequential and random access file processing.

21EL111 INTERPERSONAL SKILLS (LISTENING AND PEAKING)

L	T	P	C
0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Equip and strengthen the English language skills.
- Provide guidance and practice to engage in specific academic speaking activities and enhance
- Writing skills with specific reference to technical writing (interview skills).
- Improve general and academic listening skills.
- Demonstrate their presentation skills competently.

UNIT I **6**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics - taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

UNIT II **6**

Listen to a process information- give information, as part of a simple explanation – conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

UNIT III **6**

Deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail.

UNIT IV **6**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and participating in conversations.

UNIT V **6**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Listen and respond appropriately.
- Participate in group discussions.
- Make effective presentations.

- Participate confidently and appropriately in conversations both formal and informal.

TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Dhanavel, S P. English and Soft Skills, Volume Two, Orient Black Swan, ISBN 978 93 528769142.

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
4. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

SEMESTER II

21EL201	TECHNICAL ENGLISH	L	T	P	C
		2	0	0	2

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.
- Demonstrate 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 - TECHNICAL ENGLISH 6

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing**- purpose statements – extended definitions - writing instructions – checklists – recommendations - Vocabulary Development- technical vocabulary. Language Development –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 6

Listening- Listening to longer technical talks and completing exercises based on them - **Speaking** - describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs - Vocabulary Development- vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 6

Listening- Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

UNIT IV REPORT WRITING 6

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations-**Reading** – reading for detailed comprehension- **Writing**- Report Writing (accident and survey) - minutes of a meeting - Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- reported speech.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 6

Listening- TED talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– email etiquette- job application – cover letter – Résumé preparation (via email and hard copy)- Vocabulary Development- verbal analogies - Language Development- clauses- if conditionals.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialization successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Sudharshana. N. P and Saveetha C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES:

1. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.

2. Herbert, A. J. The Structure of Technical English.Longman.1976.
3. Kumar, Suresh. E. Engineering English. Orient Black swan: Hyderabad,2015.
4. Means, L. Thomas and Elaine Langlois, English & Communication for Colleges. Cengage Learning, USA: 2007.
5. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi,2014.

21MA201 ENGINEERING MATHEMATICS – II

L	T	P	C
3	2	0	4

OBJECTIVES:

The syllabus is designed to:

- Explain various techniques in solving ordinary differential equations.
- Make the students understand the concepts of vector differentiation and integration.
- Introduce the concepts of Laplace transforms and its applications.
- Develop an understanding on analytic function, conformal mapping and complex integration.

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+6

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS 9+6

Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (Statement only) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III LAPLACE TRANSFORMS 9+6

Laplace transforms – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms –Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform – Convolution theorem (Statement only) – Initial and final value theorems – Solution of linear ordinary differential equation of second order with constant coefficients using Laplace transformation techniques.

UNIT IV COMPLEX DIFFERENTIATION AND CONFORMAL MAPPING 9+6

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (Statement only) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z + k$, kz, $1/z$, $z2$ and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+6

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Statement and applications of Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Solve the higher order linear differential equations.
- Determine the gradient of a scalar field, divergence and curl of a vector fields and interpret their physical meaning and evaluate line, surface and volume integrals by vector integration.
- Apply Laplace Transforms method for solving linear ordinary differential equation.

- Construct an analytic function and analyze conformal mapping.
- Evaluate the real integrals using complex integration.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
3. T. Veerarajan, “Engineering Mathematics”, Tata McGraw Hill, 2nd Edition, New Delhi, 2011.

REFERENCES:

1. M. K. Venkataraman, “Engineering Mathematics, Volume I”, 4th Edition, The National Publication Company, Chennai, 2003.
2. Sivaramakrishna Dass, C. Vijayakumari, “Engineering Mathematics”, Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, ”Higher Engineering Mathematics”, S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, “Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

21CH102 ENVIRONMENTAL SCIENCE AND ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

The goal of this course is to enlighten and sensitize the students on environmental conservation and social issues. The course is designed to:

- Appreciate the natural resources of environment which are inherently created for supporting life.
- Learn scientific and technological solutions to current day pollution issues.
- Study the interrelationship between living organisms and environment
- Understand the integrated themes of biodiversity.
- Appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.

UNIT I NATURAL RESOURCES 11

Introduction - scope and importance of environment – need for public awareness.

Forest resources- Use and over-exploitation, deforestation - timber extraction, mining, dams and their effects on forests and tribal people. **Water resources** - Use and over- utilization of surface and ground water, conflicts over water, dams-benefits and problems. **Mineral resources**- Use and exploitation, environmental effects of extracting and using mineral resources. **Food resources**- World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. **Energy resources** - Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. **Land resources**- Land as a resource, land degradation, soil erosion and desertification – role of an individual in conservation of natural resources - case studies.

UNIT II POLLUTION AND ITS MANAGEMENT 11

Pollution – causes, effects and control measures - Air pollution- Water pollution - Soil pollution - Marine pollution - Noise pollution - Thermal pollution - Nuclear hazards - nuclear accidents and holocaust - role of an individual in prevention of pollution – case studies.

Waste management - causes, effects and control measures of municipal solid wastes, e- waste, plastic waste.

UNIT III ECOSYSTEMS AND BIODIVERSITY 9

Introduction to ecosystems – structure and function of an ecosystem – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids - types, characteristic features, structure and functions of - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (lakes, oceans)

Introduction to biodiversity – types (genetic, species and ecosystem diversity) –values of biodiversity – threats to biodiversity - endangered and endemic species – conservation of biodiversity (in-situ and ex-situ conservation) - India as a mega-diversity nation – hot-spots of biodiversity in India

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 8

Sustainable development – sustainable development goals - water conservation, rain water harvesting, watershed management – resettlement and rehabilitation - consumerism and waste products, value education.

Disaster management- floods, drought, earthquake, tsunami, cyclone and landslides - case studies.

Environmental ethics- issues and possible solutions – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Introduction - population growth, variation among nations, population explosion, family welfare programme – women and child welfare - environment and human health – endemic/epidemic/pandemic, COVID – 19, HIV / AIDS– role of information technology in environment and human health –environmental impact assessment- case studies.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Illustrate the importance and conservation of natural resources.
- Assess the impact of various pollutants and suggest appropriate pollution control methods.
- Explain the basic structure of ecosystem and the conservation of biodiversity.
- Analyze the social issues related to environment and recommend suitable solutions.
- Investigate the trends in population explosion and assess its impact.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik, “Perspectives in environmental studies”, New Age International, 6th edition, 2018.
2. Benny Joseph, “Environmental Science and Engineering”, Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M. Masters, Wendell P. Ela “Introduction to Environmental Engineering and Science”, 3rd edition, Pearson Education, 2015.

REFERENCES:

1. William P. Cunningham and Mary Ann Cunningham, “Environmental Science: A Global Concern”, McGraw Hill, 14th edition, 2017.
2. G. Tyler Miller and Scott E. Spoolman, “Environmental Science”, Cengage Learning India Pvt. Ltd., Delhi, 14th edition, 2014.
3. Erach Bharucha, “Textbook of Environmental Studies”, Universities Press Pvt. Ltd., Hyderabad, 2nd edition, 2015.

21GE105 COMPUTER AIDED ENGINEERING GRAPHICS

L	T	P	C
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.

UNIT I INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CAD COMMANDS 18

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to CAD commands- CAD user interface- coordinate systems, object selection methods, selection of units and precession. Sketching – line, circle, arc, polygon, rectangle and ellipse. Working with object snaps, layers and object properties. Editing the objects – copy, move, trim, extend, working with arrays, mirror, scale, hatch, fillet and chamfer. Conversion of simple pictorial diagrams to orthographic view using CAD software.

UNIT II PLANE CURVES 16

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.

UNIT III PROJECTION OF POINTS, LINES AND PLANE SURFACE 18

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.

UNIT IV PROJECTION OF SOLIDS AND PROJECTION OF SECTIONEDSOLIDS 20

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. 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.

UNIT V DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTION 18

Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. 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.

TOTAL: 90 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Illustrate the fundamentals and standards of engineering drawing and apply the concepts of orthographic projections using CAD software.
- Interpret and construct various plane curves.
- Develop orthographic projections of points, lines and plane surfaces.
- Make use of concepts in projection to draw projections of solids and interpret the concept in section of solids.
- Interpret and visualize development of surfaces.
- Interpret and visualize isometric projection of simple solids.

TEXT BOOKS:

1. Natarajan K.V.,"A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 15th Edition, 2019.

REFERENCES:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 2012.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2nd Edition, 2013.
3. Engineering Drawing Practice for Schools and Colleges SP: 46 , BIS, 2003.
4. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy 11th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 1993.
5. Parthasarathy N.S 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.

21CS201 DATA STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of ADTs
- To learn linear data structures – lists, stacks, and queues
- To understand and apply Tree data structures
- To understand and apply Graph structures
- To analyze sorting, searching and hashing algorithms

UNIT I LINEAR DATA STRUCTURES – LIST 9

Algorithm analysis-What to analyze-running time calculations-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).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Stack Model - Implementations: Array and Linked list - Applications - Balancing symbols - Evaluating arithmetic expressions - Conversion of Infix to postfix expression- Queue ADT – Queue Model - Implementations: Array and Linked list - Circular Queue – Priority Queue - deQueue – applications of queues.

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 – Priority Queues – Applications of priority queues.

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 – Cut vertex – Euler circuits – Applications of graphs.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Implement abstract data types for linear data structures.
- Apply the appropriate linear data structures to solve problems.
- Identify and use appropriate tree data structures in problem solving.
- Choose appropriate Graph representations and solve real-world applications.
- Critically analyze the various sorting and searching algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2016.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2014.

REFERENCES:

1. Narasimha Karumanchi, "Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles", Career Monk Publications, 2020.
2. Jean-Paul Tremblay and Paul Sorenson, "An Introduction to Data Structures with Application", McGraw-Hill, 2017.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in Java", Third Edition, Pearson Education, 2012.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008.
5. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, "Fundamentals of Data Structures in C++", Second Edition, Silicon Press, 2007.

21CS202	PYTHON PROGRAMMING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand and write simple Python programs.
- To write Python programs using functions and understand recursion
- To solve problems using Python data structures –- lists, tuples, dictionaries.
- To understand files, modules and packages in Python.
- To use Exceptions, Standard Libraries and IDE for application development.

UNIT I INTRODUCTION TO PYTHON 9+6

Introduction to Python programming – Arithmetic Operators - values and types - variables, expressions, statements – Functions – Conditionals and Recursion –Iteration.

UNIT II FUNCTIONS 9+6

Fruitful functions: Return Values, Incremental Development, Composition, Boolean functions, Recursion, Example, Checking Types – Strings: len, Traversal with a for loop, String slices, Immutable, Searching, Looping and Counting, String Methods, in Operator, String Comparison – Case Study: Word Play.

UNIT III LISTS, DICTIONARIES, TUPLES 9+6

Lists: Sequence, Mutable, Traversing, Operations, list slices, list methods, Map, Filter and Reduce, Deleting elements, Lists and Strings, Objects and Values, Aliasing, List Arguments.

Dictionaries: Mapping, Collection of Counters, Looping and Dictionaries, Reverse Lookup, Dictionaries and Lists, Memos, Global Variables.

Tuples: Immutable, Tuple Assignment, Tuple as Return Values, Variable-length Argument Tuples, Lists and Tuples, dictionaries and Tuples, Sequences of Sequences. Case Study: Data Structure Selection.

UNIT IV FILES, MODULES, PACKAGES 9+6

Files: Persistence, Reading and Writing, Format Operator, Filenames and Paths, Catching Exceptions - Modules: Importing a module, Packages, Creating a module.

UNIT V EXCEPTIONS, LIBRARIES 9+6

Exception Handling – Built-in Exceptions – Application Development with Python: Integrated Development Environment, Python Standard Library.

LIST OF EXPERIMENTS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Operations on Tuples:
   a. finding repeated elements
   b. slice a tuple
   c. reverse a tuple
   d. replace last value of a tuple
5. String manipulation
   a. Get a string from a given string where all occurrences of its first char have been changed to '$', except the first char itself
   b. Python function that takes a list of words and returns the length of the longest one
   c. Python program to remove the characters which have odd index values of a given string
   d. Python program to count the occurrences of each word in a givensentence.
   e. Python program that accepts a comma separated sequence of words as input and prints the unique words in sorted form
   f. Python function to reverses a string if it's length is a multiple of 4
6. List operations
   a. Find the maximum of a list of numbers
   b. Python program to remove duplicates from a list.
   c. Python program to get the smallest number from a list.
   d. Python program to print a specified list after removing the 0th, 4th and 5th elements.
   e. Python program to print the numbers of a specified list after removing even numbers from it.
   f. Python program to find the second smallest number in a list.
7. Linear search and Binary search
8. Selection sort, Insertion sort
9. Merge sort
10. First n prime numbers
11. Multiply matrices
12. Programs that take command line arguments (word count)
13. Find the most frequent words in a text read from a file
14. Simulate elliptical orbits in Pygame
15. Simulate bouncing ball using Pygame

TOTAL: 45 +30 = 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Implement simple Python programs.
- Develop Python programs using functions.
- Represent and solve compound data using Python lists, tuples, dictionaries.
- Implement and perform operations on files, modules and packages.
- Apply Exceptions, Standard Libraries and IDE for application development.

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. Martin C. Brown, Python: The Complete Reference, Mc-Graw Hill,. (Unit 4 – Chapter 5 , Unit 5 – Chapter 7, 17)

REFERENCES:

1. David Beazley, Brian K. Jones, Python Cookbook, O'Reilly, Third Edition, 2013.
2. Reema Thareja, "Problem Solving and Programming with Python", 2nd Edition, Oxford University Press 2019.
3. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
4. John V Guttag, Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
7. Kenneth A. Lambert, Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
8. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
9. Paul Gries, Jennifer Campbell and Jason Montojo, Practical Programming: An Introduction to Computer Science using Python 3, Second edition, Pragmatic Programmers, LLC, 2013.

21GE211	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		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.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE **15**

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, planning and cutting.

II MECHANICAL ENGINEERING PRACTICE **15**

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

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE **15**

1. Study of various safety measures in Electrical System
2. Draw and demonstrate the layout for a residential house wiring using energy meter, switches, fuse, indicator, LED lamp, fluorescent lamp with one of the lamps to be controlled by 2 different switches
3. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit (series and parallel circuit).
4. Measurement of energy using single phase energy meter for incandescent lamp and LED lamp.
5. Measurement of resistance to earth of an electrical equipment

IV ELECTRONICS ENGINEERING PRACTICE **15**

1. Study of Electronic components (fixed and Variable):
    i. Resistor – Measurement of resistance using colour coding and digital multimeter.
    ii. Capacitor – Measurement of capacitance using identification code, LCR meter
    iii. Inductor – Measurement of inductance using colour coding and LCR meter
2. Study of Electronic equipment:
    i. Signal generation using AFO (sine, square, triangle for various frequency and amplitude ranges)
    ii. Measurement of amplitude, frequency, peak-peak, RMS, period, DC level of sine, square and triangle waveform using CRO and DSO.
    iii. Measurement of DC voltage and current using analog and digital meters

3. Study of Electronic accessories:
    i. Circuit connection using Breadboard and wires.
    ii. Circuit connection using general purpose PCB by Soldering practice techniques.
4. Study of logic gates AND, OR, EX-OR and NOT by demonstration.
5. Generation of Clock Signal.
6. Measurement of ripple factor of HWR and FWR.
7. Study of Iron box, fan and regulator (resistive and electronics type), emergency lamp, Power Tools: (a) Range Finder (b) Digital Live-wire detector

TOTAL: 60 PERIODS

(Part A :30 periods and Part B: 30 periods)

OUTCOMES:

At the end of this course, the students will be able to:

- Develop carpentry components and pipe connections including plumbing works.
- Make use of welding equipments to join the structures
- Analyse the basic machining operations
- Develop the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Fabricate carpentry components and pipe connections including plumbingworks.
- Carry out simple wiring as per the layout given
- Measures various electrical parameters like Voltage, Current, Power factor, Energy, Earth resistance etc.
- Calculate ripple factor of a given waveform, use logic gates for simple applications.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and Other fittings.	15Sets.
2. Carpentry vice (fitted to work bench)	15Nos.
3. Standard wood working tools	15Sets.
4. Models of industrial trusses, door joints, furniture joints	5each
5. Power Tools: (a)Rotary Hammer	2Nos
(b) Demolition Hammer	2Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5Nos.
2. Welding booth with exhaust facility	5Nos.
3. Welding accessories like welding shield, chipping hammer, Wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe andother 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	One each.

ELECTRICAL

1. Assorted electrical components for house wiring (One Way Switch, Two Way Switch, Lamp Holder, Ceiling rose, LED lamp, fluorescent lamp etc) -15 Nos.
2. Electrical measuring instruments (Ammeter, Voltmeter, DRB, DIB etc) - 1 each
3. Earth Tester - 1 No.
4. Energy Meter, Ammeter, Voltmeter, Lamp load / Resistive load - 1 each

ELECTRONICS

1. Soldering guns - 10 No.
2. Assorted electronic components for making circuits (Resistor, Capacitor, Inductor, logic gates etc) - 50 Nos.
3. Small PCBs, Breadboard -10 Nos.
4. Multimeters - 10 Nos.
5. LCR Meter, DSO - 1No.
6. CRO, AFO - 5 Nos.
7. Study purpose items: Iron box, fan and regulator, emergency lamp, Range Finder, Digital Live-wire detector - 1 each

21CS211	DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To implement the basic data structures for solving simple problems.
- To implement linear and non-linear data structures.
- To understand the different operations of search trees.
- To implement graph traversal algorithms.
- To get familiarized to sorting and searching algorithms.

LIST OF EXPERIMENTS :

1. Array Manipulation
    a. Find kth smallest element in an unsorted array
    b. Find the sub array with given sum
    c. Matrix manipulations – Addition, Subtraction, Multiplication
    d. Job Sequencing: Given an array of jobs where every job has a deadline and a profit. Profit can be earned only if the job is finished before the deadline. It is also given that every job takes a single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time. Print the sequence of jobID order to maximize total profit.
2. String manipulations:
    a. Reversing a set of words and count the frequency of each letter in the string.
    b. Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
    c. Remove all the occurrences of string S2 in string S1 and print the remaining.
3. Pointers
    a. Manipulating two dimensional arrays using pointers.
    b. Print all permutations of a given string using pointers.
4. Dynamic Memory Allocation
    a. Find Largest Number.
    b. Print the list in reverse order.
5. Array implementation of List, Stack and Queue ADTs.
6. Linked list implementation of List, Stack and Queue ADTs.

7. Applications of List, Stack and Queue ADTs.
8. Implementation of Binary Trees and operations of Binary Trees.
9. Implementation of Binary Search Trees.
10. Implementation of AVL Trees.
11. Implementation of Heaps using Priority Queues.
12. Graph representation and Traversal algorithms.
13. Implement searching and sorting algorithms. Analyze and compare the time taken for various algorithms with best, average and worst case inputs.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the students will be able to:

- Write functions to implement linear and non-linear data structure operations.
- Suggest and use appropriate linear / non-linear data structure operations for solving a given problem.
- Implement different operations of search trees.
- Implement appropriate Graph representations and traversals to solve real-world applications.
- Implement and analyze various searching and sorting algorithms.

		L	T	P	C
21EL211	**ADVANCED READING AND WRITING**	**0**	**0**	**2**	**1**

OBJECTIVES:

The Course will enable learners to:

- Strengthen their reading skills.
- Enhance writing skills with specific reference to technical writing.
- Apply their critical thinking skills.
- Demonstrate their project and proposal writing.

UNIT I **6**

Reading - Strategies for effective reading - Writing - Descriptive essays- Predicting content using photos.

UNIT II **6**

Reading - Use of graphic organizers to review and aid comprehension - Writing - Expository essays.

UNIT III **6**

Reading - Speed reading techniques - Writing - Elements of a good essay - Analytical essays.

UNIT IV **6**

Reading - Genre and organization of ideas – Writing - Email writing - Job applications.

UNIT V **6**

Reading - Critical reading and thinking -Writing - Letter of recommendation - Vision statement.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.
- Apply various texts using speed reading techniques.
- Illustrate and write different types of Essays.
- Write effective emails, winning job applications and persuasive recommendations.

TEXT BOOKS:

1. Daise, Debra., Norloff, Charl., and Carne, Paul. Reading and Writing (Level 4) Oxford:Oxford University Press, 2011.
2. Ward, Colin S., and Margot, Gramer F. Reading and Writing (Level 3) Oxford: Oxford University Press, 2011.

REFERENCES:

1. Elbow, Peter. Writing Without Teachers. London: Oxford University Press, 1973. Print.
2. Goatly, Andrew, and Hiradhar, Preet. Critical Reading and Writing. New York: Routledge, 2016.
3. Liss, Rhonda, and Davis, Jason, Effective Academic Writing (Level 3).Oxford: Oxford University Press, 2006.
4. Petelin, Roslyn., and Durham, Marsha. The Professional Writing Guide: Knowing Well and Knowing Why. Warriewood, NSW: Business & Professional Publishing, 2004.
5. Suresh Kumar, E., Sandhya, B. Savithri, J., and Sreehari, P. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012.
6. Withrow, Jeans., Brookes, Gay., and Cummings, Martha Clark. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge: Cambridge University Press, 2004.

SEMESTER III

21MA301	PROBABILITY AND STATISTICS	L	T	P	C
		3	2	0	4

OBJECTIVES:

The Course will enable learners to:

- Determine the probability value of one dimensional random variables.
- Illustrate the concepts of covariance, correlation and regression.
- Discuss the concept of testing of hypothesis for small and large samples.
- Demonstrate the difference between the types of design to experiments.
- Identify and interpret the control charts for variables and attributes.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES 15

Random variable – Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 15

Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables.

UNIT III TESTING OF HYPOTHESIS 15

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.

UNIT IV DESIGN OF EXPERIMENTS 15

One way and Twoway classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT V STATISTICAL QUALITY CONTROL 15

Control charts for measurements ($\bar{X}$and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits.

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the fundamental knowledge of modern probability theory and standard distributions.
- Categorize the probability models and function of random variables based on one and two dimensional random variables.

- Employ the concept of testing the hypothesis in real life problems.
- Implement the analysis of variance for real life problems.
- Apply the statistical quality control in engineering and management problems.

TEXT BOOKS:

1. R.A. Johnson, I. Miller and J. Freund, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. J.S. Milton and J.C. Arnold, "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES:

1. J.L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. A. Papoulis, and S. Unnikrishnapillai, Probability, "Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. S.M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. R.E.Walpole, R.H.Myers, S.L. Myers and K.Ye, "Probability and Statistics for Engineers and Scientists".Pearson Education, Asia, 9th Edition, 2012.

21AM301	DIGITAL PRINCIPLES AND COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To design digital circuits using simplified boolean functions
- To design combinational circuits and sequential circuits
- To demonstrate the basic structure and operation of a computer, instructions and addressing mode.
- To construct a basic processor with pipeline.
- To evaluate the memory hierarchical system including cache memory and virtual memory.
- To discuss the different ways of communicating with I/O devices and I/O interfaces.

UNIT I DIGITAL FUNDAMENTALS 10

Number Systems - Arithmetic Operations - Binary Codes- Boolean Algebra and Logic Gates - Theorems and Properties of Boolean Algebra - Boolean Functions - Canonical and Standard Forms - Simplification of Boolean Functions using Karnaugh Map - Logic Gates – NAND and NOR Implementations.

UNIT II COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Combinational Circuits –Binary Adder - Subtractor - Decimal Adder - Binary Multiplier - Magnitude Comparator - Decoders – Encoders – Multiplexers. Sequential Circuits - Storage Elements: Latches, Flip-Flops - Registers and Counters

UNIT III COMPUTER FUNDAMENTALS 9

Basic Structure of Computers: Computer Types - Functional Units – Basic Operational Concepts - Number Representation and Arithmetic Operations - Character Representation - Performance - Historical Perspective. Instruction Set Architecture: Memory Locations and Addresses - Memory Operations - Instructions and Instruction Sequencing - Addressing Modes

UNIT IV BASIC PROCESSING UNIT AND PIPELINING 9

Basic Processing Unit: Some Fundamental Concepts - Instruction Execution - Hardware Components - Instruction Fetch and Execution Steps - Control Signals - Hardwired Control Pipelining - Basic Concept—The Ideal Case - Pipeline Organization - Pipelining Issues - Data

Dependencies - Memory Delays - Branch Delays - Resource Limitations - Performance Evaluation - Superscalar Operation.

UNIT V I/O AND MEMORY 8

Input/Output Organization: Bus Structure - Bus Operation - Arbitration - Interface Circuits - Interconnection Standards - USB, SATA. **The Memory System:** Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access - Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory - Secondary Storage

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Design digital circuits using simplified boolean functions.
CO2: Design combinational circuits and sequential circuits
CO3: Interpret the basic structure and operation of a computer, instructions and addressing mode.
CO4: Construct a basic processor with pipeline.
CO5: Evaluate the memory hierarchical system including cache memory and virtual memory.
CO6: Differentiate the different ways of communicating with I/O devices and I/O interfaces.

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, 2018.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.

REFERENCES:

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education, 2016.
2. David A. Patterson, John L. Hennessy, "Computer Organization and Design MIPS Edition: The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.

21AM302 PRINCIPLES OF ARTIFICIAL INTELLIGENCE (LAB INTEGRATED)

L	T	P	C
3	0	2	4

OBJECTIVES:

- To explain the foundations of AI and various intelligent agents
- To discuss problem solving search strategies and game playing
- To describe logical agents and first-order logic
- To illustrate problem-solving strategies with knowledge representation mechanism for solving hard problems
- To explain the basics of learning and expert systems.

UNIT I ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS 9

Introduction to AI –Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies

UNIT II PROBLEM SOLVING 9+8

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

UNIT III LOGICAL AGENTS 9+8

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic

First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining - Resolution

UNIT IV KNOWLEDGE REPRESENTATION AND PLANNING 9+8

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information

Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – Non-deterministic domains – Time, schedule, and resources - Analysis

UNIT V LEARNING AND EXPERT SYSTEMS 9+6

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty.

TOTAL: 45 +30 = 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the foundations of AI and various Intelligent agents
CO2: Apply search strategies in problem solving and game playing
CO3: Explain logical agents and first-order logic
CO4: Apply problem-solving strategies with knowledge representation mechanism for solving hard problems
CO5: Describe the basics of learning and expert systems.

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
2. Bratko, Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,1st Edition by Patterson, Pearson, India, 2015

LIST OF LAB EXERCISES:

1. Implement basic search strategies – 8-Puzzle, 8 - Queens problem, Cryptarithmetic

2. Implement Breadth First Search and Depth first Search for Water Jug problem
3. Implement A* and memory bounded A* algorithms
4. Implement Minimax algorithm for game playing (Alpha-Beta pruning)
5. Solve Tic-Tac-Toe using Python
6. Implement Unification algorithm using Python
7. Implement Hangman game using Python
8. Implement classical planning algorithms
9. Implement forward chaining and backward chaining using Python
10. Artificial Intelligence/Expert Systems in Health care
11. Mini-Project
    - Sudoku
    - Chess

21CS302	OBJECT ORIENTED PROGRAMMING (Common to CSE and AIML)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain object oriented programming concepts and fundamentals of Java
- To apply the principles of packages, inheritance, interfaces and exceptions
- To develop a Java application with I/O streams, threads and generics classes
- To use the functionalities of Strings and Collections
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

An Overview of Java - Data Types, Variables, and Arrays – Operators - Control Statements – Class Fundamentals – Declaring objects – Methods – Constructors – this keyword - Overloading methods - Overloading constructors - Access Control – Static – Final.

UNIT II INHERITANCE, INTERFACES AND EXCEPTION HANDLING 9

Inheritance: Inheritance basics, Using super, Method Overriding, Using Abstract Classes, Using final with Inheritance – Package and Interfaces: Packages, Packages and member access, Importing Packages, Interfaces, Static Methods in an Interface – Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions.

UNIT III MULTITHREADING, I/O AND GENERIC PROGRAMMING 9

Multithreaded Programming: Creating a Thread, Thread Priorities, Synchronization, Interthread Communication – I/O: I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files – Generics: Introduction, Generic class, Bounded Types, Generic Methods, Generic Interfaces, Generic Restrictions.

UNIT IV STRING HANDLING AND COLLECTIONS 9

Lambda Expressions - String Handling – Collections: The Collection Interfaces, The Collection Classes – Iterator – Map - Regular Expression Processing.

UNIT V EVENT DRIVEN PROGRAMMING 9

Event Handling - Introducing the AWT: Working with Windows, Graphics, and Text - Using AWT Controls, Layout Managers, and Menus - Introducing Swing - Exploring Swing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the object oriented programming concepts and fundamentals of Java
CO2: Develop Java programs with the packages, inheritance, interfaces and exceptions
CO3: Build Java applications with I/O streams, threads and generics classes
CO4: Apply strings and collections in applications
CO5: Develop interactive Java applications using swings and event handling mechanism

TEXT BOOK:

1. Herbert Schildt, Java:The complete reference, 11th Edition, McGraw Hill Education, 2019.

REFERENCES:

1. Cay S. Horstmann, Gary Cornell, "Core Java Volume I Fundamentals", 11th Edition, Prentice Hall, 2019.
2. Paul Deitel, Harvey Deitel, Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
3. Steven Holzner, Java 2 Black book, Dreamtech press, 2011.
4. Timothy Budd, Understanding Object-oriented programming with Java, Third Edition, Pearson Education, 2008.

		L	T	P	C
21IT403	**DATABASE MANAGEMENT SYSTEMS (Common to CSE, AIML and IT)**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the basic concepts of Data modeling and Database Systems.
- To understand SQL and effective relational database design concepts.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To understand efficient data querying and updates, with needed configuration
- To learn how to efficiently design and implement various database objects and entities

UNIT I DATABASE CONCEPTS 9

Concept of Database and Overview of DBMS - Characteristics of databases, Database Language, Types of DBMS architecture – Three-Schema Architecture -Introductions to data models types- ER Model- ER Diagrams Extended ER Diagram reducing ER to table Applications: ER model of University Database Application.

SQL fundamentals Views - Integrity Procedures, Functions, Cursor and Triggers Embedded SQL Dynamic SQL.

UNIT II DATABASE DESIGN 9

Design a DB for Car Insurance Company - Draw ER diagram and convert ER model to relational schema. Evaluating data model quality - The relational Model Schema Keys- Relational Algebra Domain Relational Calculus- Tuple Relational Calculus - Fundamental operations. Relational Database Design and Querying Undesirable Properties of Relations Functional Dependency: Closures- Single Valued Dependency Single valued Normalization (1NF, 2NF 3NF and BCNF) - Desirable properties of Decompositions 4NF - 5NF De-normalization

UNIT III TRANSACTIONS 9

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

UNIT IV DATA STORAGE AND QUERYING 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 – Overview of physical storage structure- stable storage, failure classification -log based recovery, deferred database modification, check-pointing-File Structures:-Index structures-Primary, Secondary and clustering indices. Single and multilevel indexing.

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query

optimization using Heuristics and Cost Estimation

UNIT V ADAVNCED TOPICS 9

Distributed database Implementation Concurrent transactions - Concurrency control Lock based Time stamping-Validation based. NoSQL, NoSQL Categories - Designing an enterprise database system - Client Server database.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Implement SQL and effective relational database design concepts.
CO2: Map ER model to Relational model to perform database design effectively.
CO3: Compare and contrast various indexing strategies in different database systems.
CO4: Implement queries using normalization criteria and optimization techniques.
CO5: Analyse how advanced databases differ from traditional databases.
CO6: Design and deploy an efficient and scalable data storage node for varied kind of application requirements.

TEXT BOOKS:

1. Elmasri R. and S. Navathe, "Fundamentals of Database Systems", Pearson Education, 7th Edition, 2016.
2. Abraham Silberschatz, Henry F.Korth, "Database System Concepts", Tata McGraw Hill , 7th Edition, 2021.
3. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.

REFERENCES:

1. Raghu Ramakrishnan, Gehrke "Database Management Systems", MCGraw Hill, 3rd Edition 2014.
2. Plunkett T., B. Macdonald, "Oracle Big Data Hand Book" , McGraw Hill, First Edition, 2013
3. Gupta G K , "Database Management Systems" , Tata McGraw Hill Education Private Limited, New Delhi, 2011.
4. C. J. Date, A.Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2015.
5. Maqsood Alam, Aalok Muley, Chaitanya Kadaru, Ashok Joshi, Oracle NoSQL Database: Real-Time Big Data Management for the Enterprise, McGraw Hill Professional, 2013.
6. Thomas Connolly, Carolyn Begg, "Database Systems: A Practical Approach to Design, Implementation and Management", Pearson, 6th Edition, 2015.

		L	T	P	C
21GE301	**UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY**	**2**	**2**	**0**	**3**

OBJECTIVES:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
- Strengthening of self-reflection.
- Development of commitment and courage to act.

COURSE TOPICS:

The course has 28 lectures (2 lecture hours) and 14 practice sessions (2 Tutorial hour) in 5 Units:

UNIT I **COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION**

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- The basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfil the above human aspirations: Understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT II **UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF!**

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- 'Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with disease

UNIT III **UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP**

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence
- Understanding the meaning of Respect; Difference between respect and differentiation; the other salient values in relationship

- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, Fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided society, Universal order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institutes extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT IV UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE

- Understanding the harmony in nature
- Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence.
- Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT V IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS

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

Include practice exercises and case studies will be taken up in practice (tutorial) sessions eg. To discuss the conduct as an engineer or scientist etc.

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Would become more aware of themselves, and their surroundings (family, society, nature).

CO2: Would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Would have better critical ability.

CO4: Would become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).

CO5: Would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXT BOOK:

1. R R Gaur, R Sangal, G P Bagaria, “Human Values and Professional Ethics”, Excel Books, New Delhi, Second Edition 2019.

REFERENCES:

1. A Nagaraj, “Jeevan Vidya: Ek Parichaya”, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. E. F Schumacher, "Small is Beautiful", Vintage classics, London, 1993.
3. A.N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, Third Edition 2020.
4. Maulana Abdul Kalam Azad, "India Wins Freedom", Oriental blackswan private limited, Hyderabad, 2020.
5. Mahatma Gandhi, “Hind Swaraj or Indian Home Rule”, Maheswari Publications, Delhi 2020.
6. Romain Rolland, "The life of Vivekananda and the universal gospel", Publication house of Ramakrishna Math, Kolkata, Thirty second edition 2018.
7. Romain Rolland, "Mahatma Gandhi: The man who become one with the universal being “, Srishti Publishers and Distributors, New Delhi, Sixth Edition 2013.
8. Heaton, Dennis P. "The story of stuff." (2010): 553-556.
9. Gandhi, Mohandas Karamchand, “The story of my experiments with truth: An autobiography”, Om Books International, 2018.
10. Andrews, Cecile, “Slow is beautiful: new visions of community, leisure, and joie de vivre”, New society publishers, 2006.
11. Kumarappa, Joseph Cornelius, “The economy of permanence. CP”, All India Village Industries Assn., 1946.

		L	T	P	C
21CS311	**OBJECT ORIENTED PROGRAMMING LABORATORY (Common to CSE and AIML)**	**0**	**0**	**4**	**2**

OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To implement the concepts of classes, packages, interfaces, collections, exception handling, regular expressions and file processing.
- To develop applications using event handling.

LIST OF EXERCISES:

1. Develop a Java application to generate Electricity bill. You must use one super class called EB Bill and must have two sub classes namely Domestic Bill and Commercial Bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff

   If the type of the EB connection is domestic, calculate the amount to be paid as follows:
   First 100 units - Rs. 1 per unit
   101-200 units - Rs. 2.50 per unit
   201 -500 units - Rs. 4 per unit
   > 501 units - Rs. 6 per unit

   If the type of the EB connection is commercial, calculate the amount to be paid as follows:
   First 100 units - Rs. 2 per unit
   101-200 units - Rs. 4.50 per unit
   201 -500 units - Rs. 6 per unit
   > 501 units - Rs. 7 per unit
2. Arrays Manipulations: (Use Methods for implementing these in a Class)
   a. Find k^{th} smallest element in an unsorted array
   b. Find the sub array with given sum
   c. Matrix manipulations – Addition, Subtraction, Multiplication
   d. Remove duplicate elements in an Array
   e. Accept an integer value N and print the N^{th} digit in the integer sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and so on till infinity.

   Example: The 11th digit in the sequence 12345678910111213…. is 0.
3. Develop a Java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.
4. Develop a Java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
5. Design a Java interface for ADT Stack. Implement this interface using array and built-in classes. Provide necessary exception handling in both the implementations.
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains the methods print Area () that prints the area of the given shape and Numberofsides() that prints the number of sides of the given shape.
7. Write a Java program to apply built-in and user defined exceptions.
8. String Manipulation:
   1. Reversing a set of words and count the frequency of each letter in the string.
   2. Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
   3. Remove all the occurrences of string S2 in string S1 and print the remaining.
   4. Find the longest repeating sequence in a string
   5. Print the number of unique string values that can be formed by rearranging the letters in the string S.

9. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
10. Write a Java program to read and copy the content of one file to other by handling all file related exceptions.
11. Collections:
    a. Write a program to perform string operations using ArrayList. Write functions for the following
        i. Append - add at end
        ii. Insert – add at particular index
        iii. Search
        iv. List all string starts with given letter
    b. Find the frequency of words in a given text.
12. Write a Java program to remove all non-alphanumeric characters from a string using regular expression.
13. Design a calculator using event-driven programming paradigm of Java with the following options.
    a. Decimal manipulations
    b. Scientific manipulations
14. Develop a mini project for any application using Java concepts.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
CO2: Develop and implement Java programs with collections, exception handling, regular expressions and multithreading.
CO3: Design applications using file processing and event handling

		L	T	P	C
21IT412	**DATABASE MANAGEMENT SYSTEMS LABORATORY**	**0**	**0**	**4**	**2**

(Common to CSE, AIML and IT)

OBJECTIVES:

- To understand data definitions and data manipulation commands
- To learn the use of nested and join queries
- To understand functions, procedures and procedural extensions of databases
- To be familiar with the use of a front-end tool
- To understand design and implement typical database applications

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements
2. Database Querying – Simple queries, Nested queries, Sub queries and Joins
3. Views, Sequences, Synonyms
4. Database Programming: Implicit and Explicit Cursors
5. Procedures and Functions
6. Triggers
7. Exception Handling
8. Database Design using ER modeling, normalization and Implementation for any application
9. Database Connectivity with Front End Tools

10. Case Study using real life database applications anyone from the following list
    a) Inventory Management for a EMart Grocery Shop
    b) Society Financial Management
    c) Cop Friendly App – Eseva
    d) Property Management – eMall
    e) Star Small and Medium Banking and Finance

- Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
- Apply Normalization rules in designing the tables in scope.
- Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
- Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
- Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Apply typical data definitions and manipulation commands.
CO2: Design applications to test Nested and Join Queries.
CO3: Implement simple applications that use Views.
CO4: Implement applications that require a Front-end Tool.
CO5: Critically analyze the use of Tables, Views, Functions and Procedures.

		L	T	P	C
21CS313	**APTITUDE AND CODING SKILLS – I (Common to All Branches)**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

List of Exercises:

1. **English – Phase I**
   Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering
2. **Logical Reasoning – Phase I**
   Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency
3. **Quantitative Ability - Phase I**
   Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations,

Probability

4. **Automata Fix – Phase I**
   Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

SEMESTER IV

21MA402	LINEAR ALGEBRA	L	T	P	C
		3	2	0	4

OBJECTIVES:

- Implement the concept of consistency and solve the system of linear equations.
- Illustrate the basic notions associated with vector spaces and its properties.
- Interpret the concept of linear transformations and diagonalization.
- Enumerate the orthonormal basis using inner product spaces.
- Categorize the approach of numerical methods and abstract algebra.

UNIT I **MATRICES AND SYSTEM OF LINEAR EQUATIONS** **15**

Matrices – Row echelon form – Rank – System of linear equations – Consistency – Gauss elimination method – Gauss Jordon method.

UNIT II **VECTOR SPACES** **15**

Real and Complex fields – Vector spaces over Real and Complex fields – Subspace – Linear space – Linear independence and dependence – Bases and dimensions.

UNIT III **LINEAR TRANSFORMATION** **15**

Linear transformation – Range and null space – Rank and nullity – Rank nullity Dimension theorem – Matrix representation of linear transformation – Eigenvalues and eigenvectors of linear transformation.

UNIT IV **INNER PRODUCT SPACES** **15**

Inner product and norms – Properties – Orthogonal, Orthonormal vectors – Gram Schmidt orthonormalization process – Least squares approximation.

UNIT V **EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION** **15**

Eigen value problems – Power method, Jacobi method – Singular value decomposition – QR decomposition.

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Test the consistency and solve the system of linear equations.

CO2: Identify the bases and dimensions of vector space.

CO3: Demonstrate the accurate and efficient use of advanced algebraic techniques.

CO4: Compute orthonormal basis of inner product space and least squares approximation.

CO5: Evaluate the eigen values of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS:

3. A.H. Friedberg, A. J. Insel, and L. Spence, "Linear Algebra", Prentice Hall of India, 5th Edition, New Delhi, 2008.
4. J.D. Faires, and R. Burden, "Numerical Methods", Brooks/Cole (Thomson Publications), 4th Edition, New Delhi, 2012.

REFERENCES:

1. S. Kumaresan, "Linear Algebra - A geometric approach", Prentice Hall of India, New Delhi, Reprint, 2010.
2. G. Strang, "Linear Algebra and its applications", Thomson (Brooks / Cole), 4th Edition, New Delhi, 2005.
3. C.F. Gerald and P.O. Wheatley, "Applied Numerical Analysis", 7th Edition, Pearson Educations, New Delhi, 2004.
4. Richard Branson, "Matrix Operations", Schaum's outline series, 1989.
5. Bernard Kolman, R. David R. Hill, "Introductory Linear Algebra", Pearson Educations, New Delhi, First Reprint, 2009.

21AM401 MACHINE LEARNING ESSENTIALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To discuss the basics of Machine Learning and Supervised Algorithms.
- To understand the various classification algorithms.
- To study dimensionality reduction techniques.
- To elaborate on unsupervised learning techniques.
- To design and analyze machine learning experiments.

UNIT I INTRODUCTION **9**

Machine Learning – Types – Applications – Preparing to Model – Activities – Data – Exploring structure of Data – Data Quality and Remediation – Data Pre-processing – Modelling and Evaluation: Selecting a Model -Training a Model – Model representation and Interpretability – Evaluating Performance of a Model – Improving Performance.

UNIT II FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION **9**

Feature Engineering – Feature Transformation – Feature Subset Selection - Principle Component Analysis – Feature Embedding – Factor Analysis – Singular value decomposition and Matrix Factorization – Multidimensional scaling – Linear Discriminant Analysis – Canonical Correlation Analysis – Isomap – Locally linear Embedding – Laplacian Eigenmaps.

UNIT III SUPERVISED LEARNING **9**

Linear Regression -Relation between two variables – Steps – Evaluation – Logistic Regression – Decision Tree – Algorithms – Construction – Classification using Decision Tree – Issues – Rule-based Classification – Pruning the Rule Set – Support Vector Machines – Linear SVM – Optimal Hyperplane – Radial Basis Functions – Naïve Bayes Classifier – Bayesian Belief Networks.

UNIT IV UNSUPERVISED LEARNING **9**

Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.

UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS **9**

Guidelines for Machine Learning Experiments – Cross Validation and Resampling Methods – Assessing a Classification Algorithm – Comparison – Two algorithms, multiple algorithms – Multivariate Tests

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the basics of Machine Learning and Supervised Algorithms.
CO2: Understand the various classification algorithms.
CO3: Study dimensionality reduction techniques.
CO4: Elaborate on unsupervised learning techniques.
CO5: Design and analyze machine learning experiments.

TEXT BOOKS:

1. SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019. (Unit 1 – Chap 1,2,3/ Unit 2 – Chap 4 / Unit 4 – Chap 9)
2. EthemAlpaydin, Introduction to Machine Learning, Adaptive Computation and Machine Learning Series, Third Edition, MIT Press, 2014. (Unit 2 – Chap 6 / Unit 4 – chap 8.2.3 / Unit 5 – Chap 19)

REFERENCES:

1. AnuradhaSrinivasaraghavan,Vincy Joseph, Machine Learning, First Edition, Wiley, 2019. (Unit 3 – Chap 7,8,9,10,11 / Unit 4 – 13, 11.4, 11.5,12)
2. Peter Harrington, "Machine Learning in Action", Manning Publications, 2012.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
4. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
5. Christoph Molnar, "Interpretable Machine Learning - A Guide for Making Black Box Models Explainable", Creative Commons License, 2020.

21AM402	DATA ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the fundamentals of big data and data analytics
- To discuss the Hadoop framework
- To explain about exploratory data analysis and data manipulation tools
- To analyse and interpret streaming data
- To discuss various applications of data analytics

UNIT I INTRODUCTION 9

Evolution of Big Data- Definition of Big Data-Challenges with Big Data- Traditional Business Intelligence (BI) versus Big Data- Introduction to big data analytics- Classification of Analytics- Analytics Tools- Importance of big data analytics.

UNIT II HADOOP FRAMEWORK 9

Introducing Hadoop- RDBMS versus Hadoop-Hadoop Overview-HDFS (Hadoop Distributed File System)- Processing Data with Hadoop- Managing Resources and Applications with Hadoop YARN - Interacting with Hadoop Ecosystem.

UNIT III EXPLORATORY DATA ANALYSIS 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data –

Comparing EDA with classical and Bayesian analysis – Software tools for EDA –Data transformation techniques - Introduction to NoSQL – MongoDB: RDBMS Vs MongoDB – Data Types – Query Language – Hive – Hive Architecture – Data Types – File Formats - Hive Query Language (HQL) – RC File Implementation – User Defined Functions.

UNIT IV MINING DATA STREAMS 9

The data stream model – stream queries-sampling data in a stream-general streaming problem-filtering streams-analysis of filtering- dealing with infinite streams- Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT V APPLICATIONS 9

Application: Sales and Marketing – Industry Specific Data Mining – microRNA Data Analysis Case Study – Credit Scoring Case Study – Data Mining Nontabular Data.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the fundamentals of big data and data analytics
CO2: Discuss the Hadoop framework
CO3: Explain about exploratory data analysis and data manipulation tools
CO4: Analyse and interpret streaming data
CO5: Illustrate various applications of data analytics

TEXT BOOKS:

1. Subhashini Chellappan, Seema Acharya, "Big Data and Analytics", 2nd edition, Wiley Publications, 2019.
2. Suresh Kumar Mukhiya and Usman Ahmed, "Hands-on Exploratory Data Analysis with Python", Packt publishing, March 2020.
3. Jure Leskovek, Anand Rajaraman and Jefrey Ullman," Mining of Massive Datasets. v2.1", Cambridge University Press,2019.
4. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II : A Practical Guide To Data Visualization, Advanced Data Mining Methods, and Applications, Wiley 2009.

REFERENCES:

1. Nelli, F., Python Data Analytics: with Pandas, NumPy and Matplotlib, Apress, 2018.
2. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley and Sons, 2014
3. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.
4. Michael Minelli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends", John Wiley and Sons, 2013.
5. Marcello Trovati, Richard Hill, Ashiq Anjum, Shao Ying Zhu, "Big Data Analytics and cloud computing – Theory, Algorithms and Applications", Springer International Publishing, 2016.

21AM403 OBJECT ORIENTED SOFTWARE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain software engineering principles and activities involved in building large software programs.
- To describe the process of requirements gathering, analysis and unified modelling
- To illustrate the object oriented design process.
- To analyse various traditional and object oriented testing methods

- To apply estimation techniques, schedule project activities and compute pricing.

UNIT I PRODUCT AND PROCESS 9

The Nature of Software – Defining the Discipline – The Software Process – Process models – Prescriptive Process Models – Product and Process – Agility and Process – What is an Agile Process? - Scrum – Other Agile Frameworks – Kanban – DevOps

UNIT II REQUIREMENTS AND UNIFIED MODELING 9

Requirements Engineering – Establishing the Groundwork: Nonfunctional Requirements – Requirements Gathering – Developing Use Cases – Negotiating and Validating Requirements.
Unified Modeling Language – Introduction – Static and Dynamic Models – Modelling – Introduction to the UML – UML Diagrams – UML Class Diagrams – Use-Case Diagram – UML Dynamic Modelling.

UNIT III OBJECT ORIENTED ANALYSIS AND DESIGN 9

Object oriented Analysis process – Business object Analysis – Use-case driven OOA – Business process modelling – Use case model. Design Concepts – Design Process – Design Concepts – Design Model: Design Principles and Design Elements. Architectural Design – Designing class-based components - Conducting Component Level Design – User Interface Analysis and Design – Pattern-Based Software Design.

UNIT IV SOFTWARE TESTING 9

Component Level: A Strategic Approach to Software Testing – White-Box Testing – Black Box Testing - Object Oriented Testing Integration Level: Integration Testing – AI and Regression Testing – Integration Testing in the OO Context Specialized Testing for Mobility: Web application Testing – Web Testing Strategies – Security Testing – Performance Testing – Real time Testing – Testing AI Systems – Testing Virtual Environments.

UNIT V SOFTWARE PROJECT MANAGAMENT 9

Software Metrics and Analytics: Software Measurement – Product Metrics. Creating a Viable Software Plan: The Project Planning Process – Software Scope and Feasibility – Decomposition and Estimation Techniques – Project Scheduling. Risk Management: Reactive Versus Proactive Risk Strategies – Risk Identification – Risk Projection – The RMMM Plan.
Software Process Improvement: The SPI Process – The CMMI

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Summarize software engineering principles and activities involved in building large software programs.

CO2: Describe the process of requirements gathering, analysis and unified modelling

CO3: Apply the object oriented design process.

CO4: Analyse the various traditional and object oriented testing methods

CO5: Apply estimation techniques, schedule project activities and compute pricing.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering: A Practitioner‘s Approach” , McGraw Hill International Edition, Nineth Edition, 2020.
2. Ali Bahrami, “Object Oriented Systems Development”, McGraw Hill International Edition,2017.

REFERENCES:

1. Micheal Blalh and James Rumbaugh, Object Oriented Modeling and Design with UML, 2nd edition Pearson 2013.
2. Ian Sommerville, “Software Engineering”, Tenth Edition, Pearson Education, 2016.
3. Ivar Jacobson, Harold Bud Lawson, Pan-Wei Ng, Paul E. McMahon, Michael Goedicke, “The Essentials of Modern Software Engineering”, Morgan and Claypool Publishers, 2019.
4. Booch, G, Jacobson I, Rumbaugh J, “The Unified Modeling Language User Guide”, Addison Wesley, 2008.
5. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, 3rd edition, Addison Wesley, 2003.

		L	T	P	C
21AM404	**OPERATING SYSTEM FUNDAMENTALS (LAB INTEGRATED)**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To explain the basic concepts of operating systems and process.
- To discuss threads and implement various CPU scheduling algorithms.
- To describe the concept of process synchronization and implement deadlocks.
- To analyse various page replacement schemes.
- To investigate disk scheduling algorithms.

UNIT I INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES 7+6

Introduction to OS – Computer system organization - architecture – Resource management - Protection and Security – Virtualization - Operating System Structures - Services - User and Operating-System Interface - System Calls - System Services -Design and Implementation - Building and Booting an Operating System. Process Concept - Process Scheduling - Operations on Processes - Interprocess Communication - IPC in Shared-Memory Systems - IPC in Message-Passing Systems

UNIT II THREADS AND CPU SCHEDULING 11+6

Threads and Concurrency: Overview - Multicore Programming - Multithreading Models - Thread Libraries - Implicit Threading - Threading Issues. CPU Scheduling: Basic Concepts - Scheduling Criteria - Scheduling Algorithms - Thread Scheduling - Multi-Processor Scheduling - Real-Time CPU Scheduling.

UNIT III PROCESS SYNCHRONISATION AND DEADLOCKS 9+6

Process Synchronization - The critical-section problem, Peterson’s Solution - Synchronization hardware, Mutex locks, Semaphores, monitors, Liveness - Classic problems of synchronization – Bounded Buffer Problem - Reader’s and Writer Problem, Dinning Philosopher Problem, Barber’s shop problem. Deadlock - System model - Deadlock characterization, Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection -

Recovery from deadlock.

UNIT IV MEMORY MANAGEMENT 9+6

Memory Management: Contiguous Memory Allocation - Paging - Structure of the Page Table – Swapping. Virtual Memory: Demand Paging – Copy-on write – Page Replacement – Allocation of frames – Thrashing Memory – Compression.

UNIT V FILE MANAGEMENT 9+6

File Management: File Concept – Access Methods – Directory Structure – Protection - Memory-Mapped File. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks. I/O Hardware: I/O devices, Device controllers, Direct Memory Access - Case Study-Linux.

Lab Programs:

1. Basic Unix file system commands such as ls, cd, mkdir, rmdir, cp, rm, mv, more, lpr, man, grep, sed, etc.
2. Shell Programming
3. Programs for Unix System Calls.
   a. Write a program to fetch the below information; Name of the operating system, Current release level, Current version level, Total usable main memory size, Available memory size, Amount of shared memory, Memory used by buffers, Total swap space size, and Swap space still available.
   b. Use system calls to imitate the action of UNIX command "ls" with option -a, and -li command
   c. Use system calls to imitate the action of UNIX command "cp" or "dir" with a couple of options
   d. Implement process life cycle: Use the system calls fork(), exec(), wait(), waitpid(), exit(0), abort() and kill().
4. Write a program to implement the following actions using pthreads

a) Create a thread in a program and called Parent thread, this parent thread creates another thread (Child thread) to print out the numbers from 1 to 20. The Parent thread waits till the child thread finishes

b) Create a thread in the main program, this program passes the 'count' as an argument to that thread function and this created thread function has to print your name 'count' times

5. Process Synchronization using Semaphores. A shared data has to be accessed by two categories of processes namely A and B. Satisfy the following constraints to access the data without any data loss.

   (i) When a process A1 is accessing the database another process of the same category is permitted.

   (ii) When a process B1 is accessing the database neither process A1 nor another process B2 is permitted.

   (iii) When a process A1 is accessing the database process B1 should not be allowed to access the database.

   Write appropriate code for both A and B satisfying all the above constraints using semaphores.

   Note: The time-stamp for accessing is approximately 10 sec.
6. Implementation of IPC using Shared memory
   a. Write a UNIX system call program to implement the following shared memory concept
      i) In process 1 - Creation a shared memory of size 5 bytes with read/write permission and enter balance amount of Rs 1000.

ii) In process 2 – Add Rs. 200 to your balance. During this modification maintain the atomicity of shared memory using binary semaphore

iii) In process 3 – Subtract Rs. 800 to your balance. During this also modification maintain the atomicity of shared memory using binary semaphore

iv) In process 4 – Display the current balance of shared memory

v) Delete the shared memory

7. Implementation of IPC using message queue

a) Get the input data (integer value) from a process called sender

b) Use Message Queue to transfer this data from sender to receiver process

c) The receiver does the prime number checking on the received data

d) Communicate the verified/status result from receiver to sender process, this status should be displayed in the Sender process.

Note: Simultaneously execute two or more processes. Don't do it as a single process

8. Write C programs to implement the various CPU Scheduling Algorithms
9. Bankers Algorithm for Deadlock Avoidance
10. Implementation of Page Replacement Algorithms
11. Implementation of disk scheduling

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Implement the operating system concepts and process
CO2: Analyse various CPU scheduling algorithms and thread mechanism
CO3: Implement process synchronization and deadlock problems
CO4: Design various page replacement techniques to given situation
CO5: Implement various disk scheduling techniques

TEXT BOOK:

1. Silberschatz Abraham, Greg Gagne, Peter B. Galvin. "Operating System Concepts", Tenth Edition, Wiley, 2018.

REFERENCES:

1 Ramaz Elmasri, A. Gil Carrick, David Levine, Operating Systems – A Spiral Approach‖, Tata McGraw Hill Edition, 2010.
2 Achyut S.Godbole, Atul Kahate, Operating Systems‖, McGraw Hill Education, 2016.
3 Andrew S. Tanenbaum, Modern Operating Systems‖, Second Edition, Pearson Education, 2004.
4 Gary Nutt, Operating Systems‖, Third Edition, Pearson Education, 2004.
5 Harvey M. Deitel, Operating Systems, Third Edition, Pearson Education, 2004.
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.

		L	T	P	C
20CS402	**DESIGN AND ANALYSIS OF ALGORITHMS (Common to CSE, AIML and IT)**	**2**	**2**	**0**	**3**

OBJECTIVES:

- To critically analyse the efficiency of alternative algorithmic solutions for the same problem
- To illustrate brute force and divide and conquer design techniques.

- To explain dynamic programming and greedy technique for solving various problems.
- To apply iterative improvement technique to solve optimization problems
- To examine the limitations of algorithmic power and handling it in different problems.

UNIT I INTRODUCTION 8+3

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types –Fundamentals of the Analysis of Algorithmic Efficiency – Asymptotic Notations and their properties. Analysis Framework – Empirical analysis - Mathematical analysis for Recursive and Non-recursive algorithms – Visualization.

UNIT II BRUTE FORCE AND DIVIDE AND CONQUER 10+3

Brute Force – Computing a^n – String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers – Closest-Pair and Convex - Hull Problems - Decrease and Conquer Method: Josephus Problem-Transform and Conquer Method: Presorting

UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE 11+3

Dynamic programming – Principle of optimality - Coin changing problem, Computing a Binomial Coefficient – Floyd‘s algorithm – Multi stage graph - Optimal Binary Search Trees - Longest common subsequence - Matrix-chain multiplication – Travelling Salesperson Problem – Knapsack Problem and Memory functions. Greedy Technique – Prim‘s algorithm and Kruskal’s Algorithm – 0/1 Knapsack problem - Huffman Trees.

UNIT IV ITERATIVE IMPROVEMENT 7+3

The Simplex Method-The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs-The Stable marriage Problem.

UNIT V COPING WITH THE LIMITATIONS OF ALGORITHM POWER 9+3

Lower - Bound Arguments - P, NP NP- Complete and NP Hard Problems. Backtracking – N-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Travelling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem.

TOTAL: 45+15=60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Analyse the efficiency of recursive and non-recursive algorithms mathematically

CO2: Analyse the efficiency of brute force, divide and conquer, decrease and conquer, Transform and conquer algorithmic techniques

CO3: Implement and analyse the problems using dynamic programming and greedy technique algorithmic techniques.

CO4: Solve the problems using iterative improvement technique for optimization.

CO5: Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound technique.

TEXT BOOKS:

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.
3. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein,

Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.

REFERENCES:

2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006.
3. Harsh Bhasin, Algorithms Design and Analysis, Oxford university press, 2016.
4. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
5. http://nptel.ac.in/

21AM411	Machine Learning Laboratory	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the linear models.
- To study the various probability-based learning techniques.
- To understand graphical models of machine learning algorithms.
- To apply machinelearning algorithms.

LIST OF EXERCISES:

1. Analyse the different types of discriminant function to perform machine learning classification
2. Construct a Prune Classification tree by varying the fitting parameters to calculate the model accuracy
3. Implementation of Candidate Elimination algorithm.
4. Implementation of Linear Regression.
5. Implementation of Logistic Regression
6. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select the appropriate data set for your experiment and draw graphs.
7. Implement and demonstrate the working of the decision tree-based ID3 algorithm
8. Implement Naïve Bayes theorem to classify English text.
9. Build a Simple Support Vector Machines using a data set
10. Implement a k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.
11. Construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using a standard Heart Disease Data Set
12. Apply EM algorithm to cluster a set of data. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Analyse supervised, unsupervised or semi-supervised learning algorithms for any given problem.

CO2: Apply the appropriate linear models for any given problem.

CO3: Understand the foundation of probabilistic models and apply unsupervised algorithms for clustering.

CO4: Select the appropriate graphical models of machine learning.

CO5: Apply machine learning algorithms to improve efficiency.

21AM412	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To setup Hadoop Cluster.
- To solve problems using Map Reduce Technique
- To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering
- To employ data visualization using various representations.
- To implement the bigdata storage using Hbase, Mongo DB.

LIST OF EXERCISES:

Hadoop

1. Set up a pseudo-distributed, single-node Hadoop cluster backed by the Hadoop Distributed File System, running on Ubuntu Linux. After successful installation on one node, configuration of a multi-node Hadoop cluster.
2. MapReduce application for word counting on Hadoop cluster
3. Implement an MR program that processes a given dataset
4. Implement an MR program that processes a weather dataset R
5. Implement the following using Hadoop, Map Reduce, HDFS, Hive:

   a. Perform setting up and Installing Hadoop in its two operating modes: pseudo distributed and fully distributed.

   b. Implement the following file management tasks in Hadoop: adding files and directories, retrieving files and Deleting files.

   c. (i)Performing a MapReduce Job for word search count (look for specific keywords in a file)

   (ii) Implement stop word elimination problem: Input a large textual file containing one sentence per line and a small file containing a set of stop words (one stop word per line) and save the results in an output textual file containing the same sentences of the large input file without the words appearing in the small file.

   d. Implement a MapReduce program that processes a weather data set to:

      i. Find average, max and min temperature for each year in National Climate Data Centre data set.

      ii. Filter the readings of a set based on value of the measurement. The program must save the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

   e. Install, deploy and configure Apache Spark cluster. Run Apache Spark applications using Scala.

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

R / Python

1. Implement the following algorithms on realtime stream data sets.
   - Support Vector Machine
   - Decision tree classifier
   - Clustering Algorithms
2. Implement an application that stores big data in Hbase / MongoDB / NoSQL / Pig using Hadoop / R.
3. Apply Bayesian and SVM techniques on Iris and Diabetes data set.
4. 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 classes/API

5. Given a data set, explore the features using exploratory data analysis using Python/R.

6. Solve numerical problems on Eigen Value, Eigen Vector, etc. to understand the working principles of mining techniques.

7. Mini Project: The project should contain the following components

- Realtime dataset
- Data preparation and Transformation
- Handling missing Data
- Data Storage
- Algorithm for data analytics
- Data visualization: Charts, Heatmap, Crosstab, Treemap

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Setup multi-node Hadoop Clusters

CO2: Apply Map Reduce algorithms for problems

CO3: Perform data analysis with machine learning models.

CO4: Perform graphical data analysis.

CO5: Build large datasets using Hbase, Mongo DB.

		L	T	P	C
21CS414	**APTITUDE AND CODING SKILLS – II (Common to All Branches)**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

List of Exercises:

1. **English – Phase II**
   Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering
2. **Logical Reasoning – Phase II**
   Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency
3. **Quantitative Ability - Phase II**
   Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability
4. **Automata Fix – Phase II**

Logical, Compilation and Code reuse

5. **Automata - Phase II**

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching

Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.
CO2: Build an enhanced level of logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.
CO4: Apply data structures and algorithms in problem solving.

SEMESTER V

		L	T	P	C
21MA302	**DISCRETE MATHEMATICS**	**3**	**2**	**0**	**4**

OBJECTIVES:

- Validate the arguments by using connectives and rules of inference.
- Develop the knowledge on the basics of counting, solving recurrence relations.
- Demonstrate the fundamentals of graphs.
- Illustrate the functions, relations and group theory.
- Familiarize the concepts of lattices and Boolean algebra.

UNIT I LOGIC AND PROOFS **15**

Propositional logic – Propositional equivalences – Predicates and quantifiers – Nested quantifiers – Rules of inference – Introduction to proofs – Proof methods and strategy.

UNIT II COMBINATORICS **15**

Mathematical induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications.

UNIT III GRAPH THEORY **15**

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV ALGEBRAIC STRUCTURES **15**

Algebraic systems – Semi groups and monoids – Groups – Subgroups – Homomorphisms – Normal subgroup and cosets – Lagrange‘s theorem – Definitions and examples of Rings and Fields.

UNIT V LATTICES AND BOOLEAN ALGEBRA **15**

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sublattices – Direct product and homomorphism – Some special lattices – Boolean algebra.

TOTAL: 75 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Examine the validity of the arguments.
CO2: Demonstrate various proof techniques and application of principles.
CO3: Apply graph theory techniques to solve real life problems.
CO4: Identify algebraic techniques to formulate and solve group theoretic problems.
CO5: Utilize the significance of lattices and Boolean algebra in computer science and engineering.

TEXT BOOK:

1. K.H. Rosen, "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. J.P. Tremblay, and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011.

REFERENCES:

1. R.P. Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. S. Lipschutz, and M. Lipson, "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. T. Koshy. "Discrete Mathematics with Applications", Elsevier Publications, 1st Edition, 2006.

21AM501	NEURAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithms.
- To know the issues of various feed forward and feedback neural networks.
- To gain deep insight about Boltzmann Machine Learning
- To explore Autoencoders and Hopfield Nets

UNIT I INTRODUCTION 9

A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process-A simple example of learning – Three types of Learning – Types of Neural Network Architectures

UNIT II PERCEPTRONS 9

Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron – Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment – A geometrical view of Perceptrons – What perceptrons can't do

Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

UNIT III BOLTZMANN MACHINE LEARNING 9

Learning the weights of a linear neuron-error surface – learning weights of logistic output neuron-Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, NetworkPruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated

Convergence, Supervised Learning

UNIT IV SELF ORGANIZATION MAPS 9

How a Boltzmann machine models data - Restricted Boltzmann machine- example of RBM learning-Collaborative filtering-learning layers of features by stacking RBMs.

UNIT V AUTOENCODERS AND HOPFIELD NETS 9

From PCA to autoencoders-Deep autoencoders-document retrieval- semantic hashing – learning

binary codes for image retrieval- shallow autoencoders-Hopfield Network – Hopfield Models-Hopfield nets with hidden units

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the similarity of Biological networks and Neural networks
CO2: Perform the training of neural networks using various learning rules.
CO3: Understand the concepts of forward and backward propagations.
CO4: Explain Boltzmann Machine Learning.
CO5: Construct Hopfield nets and learn autoencoders.

TEXT BOOKS:

1. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Ed
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing HouseEd. 2006.
3. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.,
4. Geoffrey Hinton and Terrence J. Sejnowski, Unsupervised Learning: Foundations of Neural Computation.

REFERENCES:

1. Neural Networks for Machine Learning – Geoffrey E. Hinton, UoFT https://www.youtube.com/playlist?list=PLLssT5z_DsK_gyrQ_biidwvPYCRNGI3iv
2. Neural Networks in Computer Intelligence, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
4. Artificial Neural Networks – B. Vegnanarayana Prentice Hall of India P Ltd 2005

21AM502 **DATA VISUALIZATION (LAB INTEGRATED)** **L T P C**
3 0 2 4

OBJECTIVES:

- To know the basics of data visualization.
- To understand the importance of data visualization.
- To explore various visualization techniques.
- To learn domain modeling techniques
- To familiarize with visualization software.

UNIT I INTRODUCTION TO DATA VISUALIZATION **9+6**

Introduction – How Visualization Works – From Graphics to Visualization – Data Representation

UNIT II VISUALIZATION TECHNIQUES – I **9+6**

Scalar Visualization – Vector Visualization – Tensor Visualization

UNIT III DOMAIN MODELING TECHNIQUES **9+6**

Cutting – Selection – Grid Construction from Scattered Points – Grid Processing Techniques

UNIT IV VISUALIZATION TECHNIQUES – II **9+6**

Image Visualization – Volume Visualization – Information Visualization

UNIT V VISUALIZATION SOFTWARE **9+6**

Taxonomies of Visualization Systems – Scientific Visualization Software – Imaging Software – Grid ProcessingSoftware – Information Visualization Software

TOTAL: 45+ 30 = 75 PERIODS

OUTCOMES:

CO1: Understand the basics and importance of data visualization.
CO2: Apply visualization techniques for different types of data sets.
CO3: Analyze the domain modeling techniques.
CO4: Apply visualization techniques for variousapplication scenarios.
CO5: Understand various visualization software.

TEXT BOOKS:

1. AlexandruTelea, Data Visualization Principles and Practice CRC Press 2014.
2. Tamara Munzer, Visualization Analysis and Design -, CRC Press 2014
3. Paul J. Deitel, Harvey Deitel, Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014.
4. Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015.

REFERENCES:

1. Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011.
2. Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.

21AM511 **NEURAL NETWORKS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

- To familiarize the basic concepts and tool used in neural networks.
- To understand structure of a neuron including biological and artificial.
- To teach learning in network (Supervised and Unsupervised)
- To design Hopfield network.
- To understand the concepts of learning rules.

LIST OF LAB EXPERIMENTS

1. Study of JAX and its installation
2. Perform matrix operations.
3. Plot multiple curves in single plot.
4. Plot Activation function used in neural network
5. Create a simple neural network
6. Create a Perceptron.
7. Pattern Classification using Perceptron network
8. Create a Back Propagation Feed-forward neural network
9. Design a Hopfield Network which stores 4 vectors
10. Illustrate how the perception learning rule works for non-linearly separable problems
11. Illustrate linearly non-separable vectors.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use JAX
CO2: Understand the similarity of Biological networks and Neural networks
CO3: Perform the training of neural networks using various learning rules.
CO4: Design Hopfield models.
CO5: Illustrate the concepts of learning rules.

21CS512	ADVANCED APTITUDE AND CODING SKILLS - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To develop vocabulary for effective communication and reading skills.
- To build the logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.

LIST OF EXERCISES:

1. English – Phase I Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase I Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase I Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase I Advanced

Logical, Compilation and Code reuse

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop vocabulary for effective communication and reading skills.
CO2: Build the logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.

21CS513	MINI PROJECT AND DESIGN THINKING PRACTICES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- Introducing students to design thinking that enhances innovation activities in terms of value creation and sustainability in problem solving.
- Strengthen students' individual and collaborative capabilities to identify problems/ needs, develop sound hypotheses, collect and analyze appropriate data, develop prototypes to collect meaningful feedback in a real-world environment.

LIST OF EXERCISES:

UNIT 1.

Introduction: Design thinking overview- Design Process – Principles of Design Thinking – Problems Best suited for Design Thinking - Visualization tool – **Case Study:** Problem Identification **(6)**

UNIT 2

Empathize – Information Gathering – Analysis – Story Telling tool- Innovation- Ideation Finding and Evaluating Ideas Mind Mapping Tool –

Case Study: Analyzing the Identified Problem.

(6)

UNIT 3

Designing Prototypes – Tasks in Prototyping –Understanding Different Prototypes- Developing

different prototypes -Demonstration –Prototyping Tools
Case Study: Prototyping the solution. **(6)**

UNIT 4

Testing and Evaluation – Testing Prototypes – Evaluation – Improving solution – Strategic Opportunities –**Case Study:** Evaluating the solution. **(6)**

UNIT 5

Applications: HealthCare and Science – Education- Transportation - Finance – Technology. **(6)**

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the design thinking process and able to visualize the problem.
CO2: Analyze the problem using innovation tools
CO3: Design a prototype for an identified problem solution
CO4: Testing and evaluate strategies in improving the solution
CO5: Apply the innovation ideas to real-world applications.

SEMESTER VI

		L	T	P	C
21AM601	**PRINCIPLES AND PRACTICES IN DEEP LEARNING (LAB INTEGRATED)**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To understand the fundamental principles, theory and approaches of deep neural networks
- To explain the key concepts, issues and practices when training and modeling with deep architectures.
- To learn the significance of deep learning improvisation techniques.
- To explore convolutional neural networks.
- To learn recurrent and recursive neural networks.

UNIT I FUNDAMENTALS OF DEEP NETWORKS 9+6

Defining Deep Learning – Common Architectural Principles of Deep Networks – Building Blocks of Deep Networks

UNIT II LEARNING IN DEEP NETWORKS 9+6

Back propagation training – Learning the weights – Chain rule – Stochastic gradient descent – Sigmoid units and vanishing gradient – Rectified Linear Unit (ReLU) and its variants – Cross entropy for classification and activation – Batch learning.

UNIT III DEEP LEARNING IMPROVIZATION TECHNIQUES 9+6

Hyper-parameter tuning, Regularization - Dropouts, Minibatch gradient descent, Data Augmentation, Stratification, Generalization Gap – Under-fitting Vs Over-fitting - Optimization – Momentum, Learning rate schedules, AdaGrad, RMSProp and Adam optimization– Internal Co-variant and Batch Normalization– Initialization – weights, Bias

UNIT IV CONVOLUTION NEURAL NETWORKS 9+6

CNN Operations – Pooling – Basic architecture – Variants of the Basic Convolution Model – Advanced architectures :AlexNet, ResNet.

UNIT V RECURRENT and RECURSIVE NEURAL NETWORKS 9+6

Recurrent Neural Networks – Bidirectional RNNs – Encoder, Decoder, Sequence-to-Sequence Architectures, Deep Recurrent Networks, Auto encoders

Recursive Neural Networks – The Challenge of Long-Term Dependencies – Echo State Networks – Long Short-Term Memory and Other Gated RNNs – Optimization for Long-Term Dependencies – Explicit Memory

TOTAL: 45+ 30 = 75 PERIODS

OUTCOMES:

CO1: Understand the fundamental principles, theory and approaches for learning with deep neural networks

CO2: Explain the key concepts, issues and practices when training and modeling with deep architectures

CO3: Apply deep learning improvisation techniques.

CO4: Implement convolutional neural networks.

CO5: Apply RNN to application scenarios

TEXT BOOKS:

1. Deep Learning: A Practitioner's Approach, Josh Patterson, Adam Gibson, O'Reilly Media, 2017
2. Deep Learning, Ian GoodfellowYoshuaBengio Aaron Courville, MIT Press, 2017
3. Neural Networks and Deep Learning, Michael Nielsen,, Determination Press

REFERENCES:

1. Deep Learning with TensorFlow: Explore neural networks with Python, Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Packt Publisher, 2017.
2. Deep Learning with Keras, Antonio Gulli, SujitPal ,Packt Publishers, 2017.
3. Deep Learning with Python'', Francois Chollet, Manning Publications, 2017.

Lab Exercises

1. Demonstration and implementation of Shallow architecture, using Python, Tensorflow and Keras
2. Hyper parameter tuning and regularization practice -
   - Multilayer Perceptron (BPN)
   - Minibatch gradient descent
3. Convolution Neural Network application using Tensorflow and Keras,
   - Classification of MNIST Dataset using CNN
   - Face recognition using CNN
   - Flower Recognition using CNN
4. Text processing, Language Modeling using RNN
5. Time Series Prediction using RNN
6. Sentiment Analysis using LSTM

21AM602 PATTERN RECOGNITION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn various classification and pattern classifier algorithms.
- To learn various unsupervised algorithms for pattern recognition.
- To study the grammars and its applications.
- To analyze feature selection and feature generation strategies.
- To use neural networks and genetic algorithms for pattern recognition.

UNIT I CLASSIFICATION and PATTERN CLASSIFIER 10

Overview of pattern recognition-Discriminant functions - Supervised learning - Parametric estimation - Maximum likelihood estimation. Bayesian parameter estimation-perceptron algorithm-LMSE algorithm-problems with Bayes approach-Pattern classification by distance functions-Minimum distance pattern classifier.

UNIT II UNSUPERVISED CLASSIFICATION 8

Clustering for unsupervised learning and classification-Clustering concept - C-means algorithm-Hierarchical clustering procedures - Graph theoretic approach to pattern clustering - Validity of clustering solution.

UNIT III STRUCTURAL PATTERN RECOGNITION 8

Elements of formal grammars-String generation as pattern description - Recognition of Syntactic description - Parsing-Stochastic grammars and applications – Graph structural based representation.

UNIT IV FEATURE SELECTION and FEATURE GENERATION 12

Pre-processing, Feature Selection Based on Statistical Hypothesis Testing, The Receiver Operating Characteristics (ROC) Curve, Class Separability Measures, Feature Subset selection, Optimal Feature Generation, Neural Networks and Feature Generation / Selection, The Bayesian Information Criterion. Linear Transforms, Regional Features, Features for Shape and Size Characterization, Typical Features for Speech and Audio Classification Template Matching: Introduction, Similarity Measures Based on Optimal Path Searching Techniques, Measures Based on Correlations, Deformable Template Models.

UNIT V NEURAL NETWORKS AND GENETIC ALGORITHM FOR PATTERN CLASSIFICATION 7

Neural network structures for pattern recognition-Neural network -based pattern associators– Self organizing networks. Pattern Classification and Optimization using Genetic Algorithm – Recent Trends.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand various classification and pattern classifier algorithms.
CO2: Elaborate various unsupervised algorithms for pattern recognition.
CO3: Discuss the grammars and its applications.
CO4: Analyse Feature selection and Feature generation techniques.
CO5: Use neural networks algorithms and genetic algorithms for pattern recognition.

TEXT BOOKS:

1. Duda R.O., and Hart.P.E.,Pattern Classification and Scene Analysis, second edition, Wiley, 2001.
2. Robert J.Schalkoff, Pattern Recognition: Statistical, Structural and Neural Approaches, John Wileyand Sons Inc., New York, 2007.
3. Trevor H, Robert T,Jerome Friedman, The Elements of Statistical Learning, Springer Series,2017.
4. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer. 2011.

REFERENCES:

1. Tou and Gonzales, “Pattern Recognition Principles”, Wesley Publication Company, London, 1974**.**
2. Morton Nadier and Eric Smith P., “Pattern Recognition Engineering”, John Wiley and Sons,NewYork, 1993.
3. S.Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2009.
4. E. Alpaydin, “Introduction to Machine Learning”, Prentice-Hall of India, 2010.
5. G. James, D. Witten, T. Hastie and R. Tibshirani, “Introduction to Statistical Learning”, Springer, 2013.

		L	T	P	C
21CS614	**ADVANCED APTITUDE AND CODING SKILLS - II**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To develop advanced vocabulary for effective communication and reading skills.
- To build an enhanced level of logical reasoning and quantitative skills.
- To develop error correction and debugging skills in programming.
- To apply data structures and algorithms in problem solving.

LIST OF EXERCISES:

1.English – Phase II Advanced

Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering

2. Logical Reasoning – Phase II Advanced

Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency

3. Quantitative Ability - Phase II Advanced

Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability

4. Automata Fix – Phase II Advanced

Logical, Compilation and Code reuse

5. Automata - Phase II Advanced

Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry

TOTAL: 30 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Develop advanced vocabulary for effective communication and reading skills.
CO2: Build an enhanced level of logical reasoning and quantitative skills.
CO3: Develop error correction and debugging skills in programming.
CO4: Apply data structures and algorithms in problem solving.

		L	T	P	C
21AM613	**INTERNSHIP AND CAREER READINESS COURSE**	**0**	**0**	**2**	**1**

OBJECTIVES:

The Course will enable learners to:

- To outline the basics of Data Warehouse concepts.
- To write queries using SQL and NoSQL.
- To discuss the features of python.
- To understand the fundamentals of Cloud.
- To familiarize the basic algorithms in AI, ML and Prompt Engineering.

MODULE I Data Warehouse Concepts, SQL, NoSQL

Data Warehouse concepts: Need for BI, Data Warehouse, Key terminologies related to DWH architecture: OLTP vs OLAP, ETL, Data Mart, Metadata, DWH Architecture, creating a DWH

Data Lakehouse: Data Lake to Data Swamp, SQL Relational Databases, Transactional Processing, Relational Database Workload Types, Architectural Challenges, Databricks Evolution

ETL: Extract Data Dump from source, Data format consistency, Data Quality rules, Truncate & Load, Load strategies, Load Approach, Transform, Mapping, Enriching, Joins, filter, Remove Duplicates, Aggregation, Load, Dimension, Facts, EDW Tables, Data Marts

Variety of ETL Tools: Apache Airflow, Datastage, Oracle Data Integrator, SSIS, Talend, Hadoop, AWS Glue, Azure Data Factory, Google Cloud Dataflow, Stitch, SAP, Hevo, Qlik, Airbyte

Informatica: Informatica Architecture, Informatica PowerCenter & Repository, Informatica PowerCenter Designer, Informatica PowerCenter workflow manager, Informatica PowerCenter workflow monitor, Run Mappings, Workflow creation & Deletion

SQL (Beginner): DQL, DDL, DML, Filtering and sorting Data, Grouping and Aggregating Data, Joins and Subqueries, Window Functions, Optimizing SQL queries, Automation.

SQL (Advanced): Store Procedure, Trigger, Views, Functions.
NoSQL: NoSQL Fundamentals and Comparison with SQL
Power BI: Connecting Data Sources and Data Bases, Data Modeling, Creating Calculated Fields in Power BI

MODULE II Python, Cloud Fundamentals

Python (Beginner): Variables, Operators, functions, Libraries, Methods, Refactoring, Enum, Tuples, Dictionaries, sets, Map, filter, reduce, Class & objects, Exceptions, Overloading
Python (Advanced): Iterators, Modules, Packages, Generators, List, Comprehensions, Regular expressions, Serialization, Partial functions, closures, Decorators
AWS: Benefits of AWS, AWS Services - Computer, Storage, Database Service, Networking Service, Security Service, Management tool Service, Developer tool Service
Azure: Cloud Computing, Services in Azure - Compute, Containers, Databases, Identity, Security, Networking, Storage
GCP: Cloud Computing, Benefits of GCP, GCP services, AWS vs Azure vs GCP
Python with Deep Learning: Python Data Science Libraries, Numpy, Scipy, Pandas, Matplotlib, Scikit-Learn, Statsmodels, Pandas, Sorting, Concatenate, Preprocessing - Time Series Data, Visualization
Python with AI: Introduction, Demand of AI, What is AI, Types of AI, Why python for AI, Python Packages for AI

MODULE III AI, ML, Prompt Engineering

Artificial Intelligence: Artificial intelligence and its types, AI Roadmap, Machine learning and its types, Linear regression Analysis, Classifications in Machine Learning
Machine Learning: AI vs ML, Classification vs regression, Supervised learning, Unsupervised learning, Training Model, Preparing Data, K-Nearest Neighbors, Naive Bayes, Logistic Regression, Support Vector Machine, Neural Networks, Tensorflow, K-Means Clustering, Principal Component Analysis, K-Means and PCA Implementations
Prompt Engineering: Introduction to AI, Linguistics, Language Models, Prompt Engineering Mindset, Zero shot and few shot prompts, AI hallucinations, Vectors/text embeddings.
Generative AI Fundamentals: Generative AI and its use cases, How do LLMS (Large Language Models) work, LLMs generates output for NLP task, LLM model decision criteria, Proprietary models, Fine tuned models, Mixing LLM flavors in workflow, Data privacy, Data security

OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Apply the basics of Data Warehouse concepts.
CO2: Apply ETL Tools for Data processing.
CO3: Write queries using SQL and NoSQL.
CO4: Apply the features of python.
CO5: Elaborate the fundamentals of Cloud and various services.
CO6: Demonstrate the basic algorithms in AI, ML and summarize the basics of Prompt Engineering.

REFERENCES:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017
4. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.
5. Brett Powell , Mastering Microsoft Power BI: Expert techniques for effective data analytics and business intelligence, Packt Publications, 2018.
6. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with

Python", Packt publishing, March 2020.
7. Ethem Alpaydin, "Introduction to Machine Learning, Adaptive Computation and Machine Learning Series", Third Edition, MIT Press, 2015.
8. Nathan Hunter, The Art of Prompt Engineering with Chatgpt: A Hands-On Guide: 3 (Learn AI Tools the Fun Way!), Shroff/Hunter Publishers, 2023
9. Joseph Babcock and Raghav Bali, Generative AI with Python and TensorFlow 2, Packt Publications, 2021.

SEMESTER VII

		L	T	P	C
21AM701	**NATURAL LANGUAGE PROCESSING (LAB INTEGRATED)**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To learn the fundamentals of natural language processing and perform word level analysis.
- To perform speech synthesis and speech recognition.
- To understand the significance of Syntactic analysis.
- To understand the role of semantics and pragmatics.
- To learn discourse algorithms and various lexical resources.

UNIT I WORDS **9+6**

Regular Expressions and Automata – Words and Transducers – N-grams – Part of Speech Tagging – Hidden Markov and Maximum Entropy Model.

UNIT II SPEECH **9+6**

Phonetics – speech Synthesis – Automatic Speech Recognition – Speech Recognition: Advanced Topics – Computational Phonology

UNIT III SYNTAX **9+6**

Formal Grammars of English – Syntactic Parsing – Statistical Parsing – Features and Unification – Language and Complexity

UNIT IV SEMANTICS AND PRAGMATICS **9+6**

The representation of meaning – Computational Semantics – Lexical Semantics – Computational Lexical Semantics – Computational Discourse

UNIT V APPLICATIONS **9+6**

Information Extraction – Question Answering and Summarization – Dialog and Conversational Agents – Machine Translation

TOTAL: 45+ 30 = 75 PERIODS

OUTCOMES:

CO1: Apply the fundamentals of natural language processing and perform word level analysis.
CO2: Perform automatic speech recognition.
CO3: Analyze the syntax using various methods.
CO4: Understand the role of semantics and pragmatics.
CO5: Create applications using NLP.

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2019.

REFERENCES:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, O'Reilly Media, 2009.
2. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
3. Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
4. NitinIndurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
5. TanveerSiddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Lab Exercises

1. Implement Text Analytics: Tokenize a given text, tokenize text with stop words as delimiters, and remove stop words in a text.
2. Find the most common words in the text excluding stop words.
3. Implement NLP Application to understand Twitter sentiment.
4. Implement Sentiment Analysis using LSTM.
5. Machine translation from Indian language to English and vice versa
6. Creating a chatbot like a help desk for any application.
7. Alexa speech enabled application development
8. Google voice API based speech transcription.

		L	T	P	C
21AM702	**COMPUTER VISION**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection.
- To become familiar with feature based alignment and motion estimation.
- To develop skills on 3D reconstruction.
- To understand image based rendering and recognition.

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT IV 3D RECONSTRUCTION 9

Shape from X - Active range finding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Analyze and apply basic image processing techniques in practical applications.
CO2: Compare the concepts related to feature detection, matching and detection.
CO3: Implement feature-based alignment and motion estimation in real-world applications.
CO4: Create and Apply 3D Reconstruction techniques in diverse applications.
CO5: Perform image-based rendering and recognition.
CO6: Implement efficient solutions to image processing and computer vision problems.

TEXT BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Person Education, Second Edition, 2015

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

PROFESSIONAL ELECTIVES (PE)

SEMESTER V/VI – PROFESSIONAL ELECTIVE – I / II /III

		L	T	P	C
21AM901	**QUANTUM MACHINE LEARNING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the essentials of quantum computing.
- To learn the science of quantum information.
- To explore quantum machine learning algorithms.
- To implement quantum k-means clustering and k-medians algorithm..
- To understand the quantum machine learning techniques.

UNIT I RISE OF THE QUANTUM MACHINES:FUNDAMENTALS 8

Essentials of Quantum Computing-Quantum Operators and Gates-No Cloning Theorem-Grover's Algorithm-Shor's Algorithm-Heisenberg's Uncertainty Principle

UNIT II QUANTUM INFORMATION SCIENCE 8

Quantum information-Entropy: Classical vs Quantum-Quantum teleportation-Quantum Parallelism and function evaluation-Quantum computing systems

UNIT III QUANTUM MACHINE LEARNING ALGORITHMS-I 8

Quantum complexity- Quantum feature maps- Quantum embedding-Information encoding-Deutsch-Jozsa algorithm- Quantum phase estimations- Quantum programming with Rigetti Forest-Measurement and mixed states-Open and closed Quantum systems- Quantum PCA

UNIT IV QUANTUM MACHINE LEARNING ALGORITHMS-II 8

Schmidt Decomposition-Quantum metrology-Linear models- Quantum k-means clustering-Quantum k- medians algorithm

UNIT V QUANTUM MACHINE LEARNING TECHNIQUES 8

HHL algorithm-QUBO-Variational quantum circuits-quantum SVM- Quantum computing with D-wave-Solving NP-hard problems-unsupervised learning and optimization.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1:Understand the essentials of quantum computing.

CO2:Explain the science of quantum information.

CO3: Implement quantum machine learning algorithms.

CO4: Implement quantum k-means clustering and k-medians algorithm..

CO5: Understand the quantum machine learning techniques.

TEXT BOOKS:

1. SantanuGanguly, Quantum Machine Learning: An Applied Approach,APress,2021
2. SantanuPattanayak, Quantum Machine Learning With Python: Using Cirq from Google Research and IBM Qiskit

REFERENCES:

1. Learn Quantum Computing with Python and IBM Quantum Experience: A hands-on introduction to quantum computing and writing your own quantum programs with Python
2. Michael A.Neilson and Isaac L.Chuang, Quantum Computation And Quantum Information,2013.

21AM902 NATURE INSPIRED COMPUTING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of nature inspired techniques which influence computing
- To learn the computing inspired by nature
- To study the Swarm Intelligence
- To know about Immuno computing techniques
- To familiarize with DNA Computing

UNIT I INTRODUCTION 9

From Nature to Natural Computing – Philosophy - Three Branches: Overview - Conceptualization - Individuals, Entities and agents - Parallelism and Distributivity -Interactivity, Adaptation- Feedback-Self-Organization-Complexity, Emergence and Reductionism - Bottom-up Vs Top-Down-Determination, Chaos and Fractals.

UNIT II COMPUTING INSPIRED BY NATURE 9

Evolutionary Computing - Hill Climbing and Simulated Annealing - Darwin's Dangerous Idea - Genetics Principles - Standard Evolutionary Algorithm -Genetic Algorithms – Crossover – Mutation - Evolutionary Programming - Genetic Programming.

UNIT III SWARM INTELLIGENCE 9

Introduction - Ant Colonies - Ant Foraging Behavior - Ant Colony Optimization, S-ACO Algorithm - Scope of ACO algorithms - Ant Clustering Algorithm (ACA) - Swarm Robotics -Foraging for food - Social Adaptation of Knowledge - Particle Swarm and Particle Swarm Optimization (PSO).

UNIT IV IMMUNOCOMPUTING 9

Introduction- Immune System - Physiology and main components - Pattern Recognition and Binding - The Immune Network Theory- Danger Theory - Evaluation Interactions - Immune algorithms - Bone Marrow Models - Forrest's Algorithm - Artificial Immune Networks.

UNIT V COMPUTING WITH NEW NATURAL MATERIALS 9

DNA Computing: Introduction - The DNA Molecule – Manipulating DNA - Adleman's experiment - Test tube programming language - Universal DNA Computers - PAM Model - Splicing Systems - Lipton's Solution to SAT Problem - Scope of DNA Computing - From Classical to DNA Computing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics Natural systems.
CO2: Analyze the concepts of Natural systems and its applications.
CO3: Learn Ant Colony Optimization and Swarm Robotics.
CO4: Articulate immune algorithms and Artificial immune networks.
CO5: Learn DNA Molecule and Scope of DNA computing.

TEXT BOOKS:

1. Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman and Hall/ CRC, Taylor and Francis Group, 2007.

REFERENCES:

1. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
2. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
3. Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005.

21AM903	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the concepts of Reinforcement Learning
- To understand Monte Carlo Decision Process and Dynamic Programming.
- To understand temporal difference learning.
- To know how functional approximation is used in reinforcement learning.
- To study basics of Deep Reinforcement Learning.

UNIT I INTRODUCTION TO REINFORCEMENT LEARNING 9

Introduction - Elements of RL, History of RL- Limitation and Scope - Examples – Multi-arm Bandits – n-armed Bandit Problem – Action-Value Methods – Incremental Implementation – Nonstationary Problem – Optimistic Initial Values – Upper Confidence Bound Action Selection – Gradient Bandits – Contextual Bandits.

UNIT II MONTE DECISION PROCESS AND DYNAMIC PROGRAMMING 9

Finite Markov Decision Processes - The Agent Environment interface - Goals and Rewards – Returns – Episodic and Continuing Tasks Markov Property – MDP - Value functions – Optimality and Approximation - Dynamic Programming - Policy Evaluation - Policy Improvement, Iteration - Value Iteration - Asynchronous DP- Efficiency of DP - Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control- Off - policy Monte Carlo Prediction – Off-Policy Monte Carlo Controls.

UNIT III TEMPORAL DIFFERENCE LEARNING 9

Temporal-Difference prediction – Advantages of TD Prediction Methods -Optimality of TD(0) – Sarsa: On-policy TD Control – Q Learning: Off-Policy TD Control – n-step TD Prediction – Forward view – Backward view – SARSA – Watkins's Q – Off-policy Eligibility Traces.

UNIT IV FUNCTION APPROXIMATION METHODS 9

Value Prediction with function Approximation – Gradient Descent Methods – Linear Methods – Control with Function Approximation – Off-Policy Approximation of Action Values – Policy Approximation – Actor-Critic Methods – Eligibility Traces – R-Learning and the Average-Reward Setting.

UNIT V DEEP REINFORCEMENT LEARNING 9

Deep Q-Learning – Rainbow DQN – DQN Improvements – Policy Gradient Methods – Benefits – Calculation – Theorem – Policy Functions – Implementation -Hierarchical RL – Multi-Agent RL.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Learn about the concepts of Reinforcement Learning.
CO2: Understand the concept of Dynamic Programming and Monte Carlo Decision Process
CO3: Understand the concept of Temporal difference Learning (TML)
CO4: Describe how functional approximation is used in reinforcement learning.
CO5: Learn the basics of Deep Reinforcement Learning.

TEXT BOOKS:

1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, Second Edition, 2020.
2. Phil Winder, "Reinforcement Learning: Industrial Applications of Intelligent Agents". Oreilly, 2021.

REFERENCES:

1.Kevin Murphy, "Machine Learning - A Probabilistic Perspective" , MIT press, 2012.
2.Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

21AM904	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic speech signal characteristics and analysis.
- To learn the various speech compression techniques
- To understand the speech recognition techniques
- To elaborate on the speaker recognition methods
- To familiarize speech synthesis techniques

UNIT I SPEECH SIGNAL CHARACTERISTICS and ANALYSIS 9

Speech production process - Representing speech in time and frequency domains - speech sounds and features- Short-Time Speech Analysis - Short- Time Average Energy and Magnitude, Zero-Crossing Rate - Short-Time Autocorrelation Function - Cepstrum Analysis – Applications – Mel-Scale Cepstrum.

UNIT II SPEECH COMPRESSION 9

Sampling and Quantization of Speech (PCM) - Linear predictive coding (LPC) – Linear Delta Modulation - Adaptive Delta Modulation – Adaptive Differential Pulse-Code Modulation – Vector Quantization (VQ) Coders .

UNIT III SPEECH RECOGNITION 9

LPC for speech recognition- Hidden Markov Model (HMM)- Training procedure for HMM- subword unit model based on HMM- Language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition.

UNIT IV SPEAKER RECOGNITION 9

Verification vs Recognition – Recognition Techniques -Features that Distinguish Speakers -System Design – Language and Accent Identification.

UNIT V SPEECH SYNTHESIS 9

Speech synthesis – Principles – Types of Stored Speech Units to Concatenate – Memory Size – Synthesis Method – Limited-Text (Voice-Response) Systems – Unrestricted Text (TTS) Systems - Synthesizer Methods -Intonation – Speech synthesis for Different Speakers – Other Languages – Evaluation of TTS Systems -Practical Speech Sythesis.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basic speech signal characteristics and analysis.CO2:
Learn the various speech compression techniques.
CO3: Understand the speech recognition techniques.
CO4: Learn on the speaker recognition methods.
CO5: Understand speech synthesis techniques.

TEXT BOOKS:

1. Donglos O shanhnessy ―Speech Communication: Human and Machine ―, 2nd Ed. University press 2001. (unit 1, 2, 4, 5)
2. Lawrence Rabiner, Biing-Hwang Juang and B.Yegnanarayana, "Fundamentals of Speech Recognition", Pearson Education, 2009 (unit 1, 3)

REFERENCES:

1. Daniel Jurafsky and James H. Martin, Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition, Pearson education, Third Edition, 2020.
2. Ben Gold and Nelson Morgan ―Speech and Audio signal processing- processing and perception of speech and music‖, John Wiley and sons 2006
3. L. R. Rabiner and R. W. Schafer, Introduction to Digital Speech Processing- Foundations and Trends in Signal Processing, 2007, Now Publishers. (Unit 2).
4. Claudio Becchetti, Klucio Prina Ricotti, Speech Recognition: Theory and C++ implementation,Wiley publications 2008.

21AM905	INFORMATION EXTRACTION AND RETRIEVAL	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize with the basics of information extraction and retrieval.
- To explain index construction, compression, scoring and vector space model.
- To understand the methods of computing scores in a search engine.
- To learn evaluation and relevance feedback in information retrieval.
- To elaborate on the XML retrieval and Web crawling.

UNIT I INTRODUCTION 9

Information Retrieval – Processing Boolean Queries – Character sequence decoding – Tokenization – Stop words – Normalization – Stemming and lemmatization – skip pointers – Bitword indexes – Positional indexes – Combination schemes – Search structures for dictionaries – wildcard queries.

UNIT II INDEXING 9

Blocked sort-based indexing – Single-pass n-memory indexing – Distributed indexing – Dynamic indexing – types of indexes – Index Compression – heap's law – Zipf's Law – Ditionary Compression – Postings file compression – Parametric and zone indexes – Term frequency and weighting – Vector space model for scoring – Variant tf-idf functions.

UNIT III SCORING AND RANKING 9

Efficient scoring and Ranking – Component of and Information Retrieval system – Vector space scoring and query operator interaction.

UNIT IV EVALUATION AND RELEVANCE FEEDBACK 9

Evaluation – Standard test collections – Evaluation of unranked retrieval sets – ranked retrieval – Assessing relevance – Relevance feedback and pseudo relevance feedback – Rocchio algorithm – Probabilistic relevance feedback – Web – Strategies – Pseudo relevance feedback – Indirect relevance feedback.

UNIT V ADVANCE CONCEPTS IN IR 9

Basic XML retrieval – Clustering in information retrieval – Web crawling – features – Crawling – Distributing indexes – Connectivity servers -Web as a graph – PageRank – Hubs and Authorities.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Describe the basics of information extraction and retrieval.
CO2: Explain index construction, compression, scoring and vector space model.
CO3: Understand the methods of computing scores in a search engine.
CO4: Discuss evaluation and relevance feedback in information retrieval.CO5:
Elaborate on the XML retrieval and Web crawling.

TEXT BOOKS:

1. Manning, Raghavan and Schutze, Introduction to Information Retrieval, Cambridge University Press, 2009.

REFERENCES:

1. Stefan Buttcher, Charles LA Clarke, Gordan V Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2016.
2. Gerald Kowalski, "Information Retrieval Architecture and Algorithms", Springer, 2014. Mark T. Maybury, "Multimedia Information Extraction", Wiley (IEEE), John Wiley and Sons, 2012.

21AM906	STATISTICAL LEARNING THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basics of statistical learning
- To discuss about the linear models for regression
- To explain linear models for classification
- To summarize the regularization methods
- To apply kernel smoothing and evaluate models

UNIT I INTRODUCTION TO STATISTICAL LEARNING 9

Introduction – Statistical Learning – Assessing model accuracy – Probability – probability densities – Two dimensions – random numbers – density functions – higher dimensions – joint and conditional densities – expected value and variances – loss of large numbers – Bayes theorem – Bayes decision rule.

UNIT II LINEAR MODELS FOR REGRESSION 9

Linear regression model and least squares – subset selection – shrinkage methods – Derived Input Directions – Comparison – Multiple Outcomes –Incremental Forward stagewise regression – Piecewise - Linear Path Algorithms – Dantzig Selector – Grouped Lasso – Properties of Lasso – Pathwise Coordinate Optimization.

UNIT III LINEAR MODELS FOR CLASSIFICATION 9

Linear Regression of an Indicator Matrix – Linear Discriminant Analysis – Logistic Regression – Fitting Models – Example – Quadratic Approximation and Inference – Regularized Logistic Regression – Separating Hyperplanes.

UNIT IV REGULARIZATION 9

Piecewise Polynomials and Splines – Filtering and feature extraction – Smoothing Splines – Automatic Selection of Smoothing parameters – Nonparametric Logistic Regression – Multidimensional Splines – Regularization and Reproducing Kernel Hilbert Spaces – Wavlet Smoothing.

UNIT V KERNEL SMOOTHING AND MODEL EVALUATION 9

One-Dimensional Kernel Smoothers – Selecting the Width – Local Regression – Structured Local Regression – Local Likelihood – Kernel Density Estimation and Classification – Radial Basis Functions – Mixture Models – Bias, Variance and Model Complexity – Bias–Variance Decomposition – Optimism – Cross-Validation.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

Define the basics of probability, random numbers and density function in statistical learning

CO2: Discuss about various linear models for regression.

CO3: Explain linear regression techniques for classification.

CO4: Identify smoothing parameters and non-parametric logistic regression.

CO5: Apply kernel smoothing and evaluate models

TEXT BOOKS:

1. Hastie, Tibshirani and Friedman, "The Elements of Statistical Learning – Data Mining, Inference and Prediction", Springer ,2nd edition 2017.

REFERENCES:

1. Sanjeev Kulkarni, Gilbert Harman, An Elementary Introduction to Statistical Learning Theory Wiley Series in Probability and Statistics Book 2011
2. Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer 2013
3. Taylor Arnold, Michale Kane, Bryan W. Lewis, A Computational approach to statistical learning, CRC Press 2019.
4. David Spiegelhalte , The Art of Statistics: Learning from Data (Pelican Books) 2020
5. V. N. Vapnik. Statistical Learning Theory. Wiley, 1998.

21AM907 AI in BLOCK CHAIN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge in Blockchain Technologies.
- To Understand how block chain and AI can be used to innovate.
- To explain Cryptocurrencies and AI.
- To develop applications using blockchain.
- To understand the limitations and future scope of AI in Blockchain.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Overview – Blockchain vs Distributed Ledger Technology vs Distributed Databases – Public vs private vs permissioned blockchains – Privacy in blockchains – Bitcoins – Ethereum – Hyperledger – Blockchain platforms – Consensus Algorithms – Building DApps with blockchain tools.

UNIT II BLOCKCHAIN AND ARTIFICIAL INTELLIGENCE 9

AI and BlockChain driven Databases – Centralized vs Distributed data – Blockchain data – Big data for AI analysis – Global databases – Data Management in a DAO.

Benefits of combining blockchain and AI – Aicumen Technologies -Combining blockchain and AI to humanize digital interactions.

UNIT III CRYPTOCURRENCY AND AI 9

Role of AI in cryptocurrency – cryptocurrency trading – Making price predictions with AI – Market making – future of cryptocurrencies.

UNIT IV DEVELOPING BLOCKCHAIN PRODUCTS 9

Development Life Cycle of a DIApp – Designing a DIApp – Developing a DIApp – Testing – Deploying – Monitoring – Implementing DIApps.

UNIT V LIMITATIONS AND FUTURE OF AI WITH BLOCKCHAIN 9

Technical Challenges – Business Model Challenges – Scandals and Public perception – Government Regulation – Privacy Challenges for Personal Records – Convergence of AI with Blockchain – Future – Enterprise.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Acquire knowledge in Blockchain Technologies.
CO2: Understand how block chain and AI can be used to innovate.
CO3: Explain Cryptocurrencies and AI.
CO4: Develop applications using blockchain.
CO5: Understand the limitations and future scope of AI in Blockchain.

TEXT BOOKS:

1. Ganesh Prasad Kumble, Anantha Krishnan, "Practical Artificial Intelligence and Blockchain: A guide to converging blockchain and AI to build smart applications for new economies", Packt Publications, 2020. (unit 1-5)
2. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015. (unit 5)

REFERENCES:

1. Daniel Drescher, "Block Chain Basics", Apress; 1st edition, 2017.
2. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

21AM908 KNOWLEDGE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Knowledge Engineering.
- To discuss reasoning under uncertainty.
- To design and develop ontologies.
- To apply reasoning with ontologies and rules.
- To understand learning and rule learning.

UNIT I INTRODUCTION 9

Knowledge, Representation and Reasoning - Need for Logic – First order logic – Syntax – Semantics – Pragmatics- Implicit and Explicit Belief - Expressing Knowledge - Resolution – Propositional case - Horn Logic – Horn clauses - Procedural Control of Reasoning.

UNIT II REASONING UNDER UNCERTAINTY 9

Introduction – Abductive reasoning – Probabilistic reasoning: Enumerative Probabilities – Subjective Bayesian view – Belief Functions – Baconian Probability – Fuzzy Probability – Uncertainty methods - Evidence-based reasoning – Intelligent Agent – Mixed-Initiative Reasoning – Knowledge Engineering – Evidence-based reasoning task: Intelligent Analysis.

UNIT III ONTOLOGIES – DESIGN AND DEVELOPMENT 9

Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development – Domain Understanding and Concept Elicitation – Modelling-based Ontology Specification.

UNIT IV REASONIING WITH ONTOLOGIES AND RULES 9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and Ontology Matching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge - Rules in Production Systems - Object-Oriented Representation - Structured Descriptions.

UNIT V LEARNING AND RULE LEARNING 9

Machine Learning – Concepts – Generalization and Specialization Rules – Types – Inductive concept learning from Examples – Learning with an Incomplete Representation Language – Formal definition of Generalization.
Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of Knowledge Engineering.
CO2: Discuss reasoning under uncertainty.
CO3: Design and develop ontologies.
CO4: Apply reasoning with ontologies and rules.
CO5: Understand learning and rule learning.

TEXT BOOKS:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016. (Unit 3 – Chapter 5, 6, Unit 4 - 7 , Unit 5 – Chapter 8, 9)

REFERENCES:

1. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
2. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
3. King (2009), Knowledge Management and Organizational Learning , Springer
4. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

		L	T	P	C
21AM909	**APPLICATIONS OF AI IN HEALTHCARE**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the principles of image formation, image enhancement and image segmentation.
- To learn the various techniques of machine intelligence for medical image analysis.
- To explore computer vision techniques for healthcare applications.
- To develop the ability to design and analyzethe protein structures and the applications of AI in drug discovery.
- To understand the soft computing techniques for medical diagnosis.

UNIT I FUNDAMENTALS OF MEDICAL IMAGE PROCESSING 9

Principles of Image Formation – Coordinate System: Body – Scanner – Scene – Structure – Display; Image Enhancement using Histogram Processing – Noise Suppression: Image Filtering: Gaussian Filtering – Median Filtering – Unsharp Masking– Adaptive Filtering Edge Detection- Image Quality Metrics – Image Artifacts – Linear Filtering – Convolution and Correlation- Algorithms to remove noise- Image Segmentation – Region Based – Edge Based – Morphological Operations – Dilation – Erosion – Chain code – Feature Extraction

UNIT II MACHINE INTELLIGENCE FOR MEDICAL IMAGE ANALYSIS 9

Data labelling – Feature Computation and selection – The learning process – Neuronal algorithms: Bayes Classifier, Linear Classifier, Decision trees , Random forests, Neural networks to diagnose a wide variety of medical conditions such as screening for common cancers- classify tumors in PET images/ — Automated CT Scanners - Deep learning architectures for segmentation – U-Net

UNIT III COMPUTER VISION FOR HEALTHCARE APPLICATIONS 9

Computer Vision to see - Computer Vision for Cognition - Computer Vision for physical rehabilitation and training - Computer Vision for CADsystems in surgery - Computer Vision for human-machine interaction - Computer Vision for Ambient Assisted Living - Egocentric (first person) vision.

UNIT IV PROTEIN STRUCTURE MODELING AND DRUG DISCOVERY 9

Protein secondary structure: Introduction, Hydrogen bond, Defining a secondary structure element, Methods for predicting secondary structure; Experimental methods for protein structure determination: X-ray crystallography, Nuclear magnetic resonance (NMR); Protein folding and dynamic simulation

Computer Aided Drug Designing (CADD): SBDD, LBDD, Drug discovery, Drug Target Identification, Drug Target Validation

UNIT V SOFT COMPUTING FOR MEDICAL DIAGNOSIS 9

Artificial neural networks in medical diagnosis, Clinical Decision Support Systems, Genetic algorithms for feature selection in computer-aided diagnosis

Fuzzy-neural networks for medical diagnosis and disease classification, Combining Evolutionary and Fuzzy techniques in medical diagnosis and disease classification.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the principles of image formation, image enhancement and image segmentation.CO2: Implement various techniques of machine intelligence for medical image analysis.

CO3: Understand the computer vision techniques for healthcare applications.

CO4: Design and analyze the protein structures and understand the applications of AI in drug discovery.

CO5: Apply soft computing techniques for medical image processing and medical diagnosis .

TEXT BOOKS:

1. Biomedical Image Analysis, Rangaraj M. Rangayyan, 2004
2. Ranjay Krishna, "Computer Vision: Foundations and Applications", Stand ford University, December 2017.
3. Richard Szeliski, ―Computer Vision: Algorithms and Applications‖, Springer 2011
4. S.N. Sivanandam, S.N. Deepa ―Principles of Soft Computing‖, 3rd Edition, Wiley, 2018. .

REFERENCES:

1. Medical Image Analysis, A. Dhawan, Wiley 2003
2. Simon J. D. Prince, ―Computer Vision: Models, Learning, and Inference‖, CambridgeUniversity Press, 2012.
3. Bioinformatics Databases: Design, Implementation, and Usage (Chapman and Hall/ CRCMathematical Biology and Medicine), by SorinDraghici
4. Andries P. Engelbrecht, ―Computational Intelligence: An Introduction‖, 2nd Edition, John Wiley and Sons, 2007.
5. TamalikaChaira, ―Medical Image Processing: Advanced Fuzzy Set Theoretic Techniques‖, CRC Press, 2015.
6. Manfred Schmitt, Horia-Nicolai TEODORESCU, Ashlesha Jain, Ajita Jain, Sandhya Jain. "Computational Intelligence Processing in Medical Diagnosis", Springer Science and BusinessMedia, 2002.

21AM910	AUTOMATA THEORY AND COMPILER DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain finite state machines for modeling and their power to recognize the languages.
- To summarize the concept of Regular languages and context free languages.
- To construct PDA and Turing machines for the given set of languages.
- To build the lexical and Syntax analyzer phases of compiler.
- To model SDD's using Intermediate Representations.

UNIT I FUNDAMENTALS AND FINITE AUTOMATA 9

Fundamentals: Formal Languages, Strings, Alphabets, Languages, Chomsky Hierarchy of languages.

Finite Automata: Introduction to Finite State machine, Acceptance of strings and languages, Deterministic finite automaton (DFA) and Non-deterministic finite automaton (NFA), Equivalence of NFA and DFA – Equivalence of NDFAs with and without €-moves, Minimization of finite automata, Equivalence between two DFA's, Finite automata with output – Moore and Mealy machines, conversion of Moore to Mealy and Mealy to Moore

UNIT II REGULAR LANGUAGES AND CFG 9

Regular Languages: Regular expressions, Identity rules, Conversion of a given regular expression into a finite automaton, Conversion of finite automata into a regular expression, Pumping lemma for regular sets, Closure properties of regular sets (proofs not required).

Context Free Grammars: Context free grammars and languages, Derivation trees, Leftmost and rightmost derivation of strings and Sentential forms, Ambiguity, left recursion and left factoring in context free grammars, Minimization of context free grammars, Normal forms for context free grammars, Chomsky normal form, Greibach normal form, Pumping Lemma for Context free Languages, Closure and decision properties of context free languages.

UNIT III PUSHDOWN AUTOMATA AND TURING MACHINE 9

Pushdown Automata: Introduction to Pushdown automata, Acceptance of context free languages, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of context free grammars and pushdown automata, Inter-conversion (Proofs not required).

Turing Machine: Introduction to Turing Machine, Design of Turing machines, Types of Turing machines.

UNIT IV COMPILER DESIGN: LEXICAL AND SYNTAX ANALYSIS 9

Introduction To Compiling: Overview of Compilers, Phases of a Compiler.

Lexical Analysis: The Role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, A language for specifying Lexical Analyzers(LEX).

Syntax Analysis: The role of the Parser, First and Follow, Predictive Parsing, LR Parsers-SLR, Canonical LR, LALR, Parser Generator(YACC).

UNIT V SYNTAX DIRECTED TRANSLATION AND INTERMEDIATE CODE GENERATION 9

Syntax-Directed Translation: Syntax-Directed Definition, S-Attributed SDD, L-Attributed SDD, Translation Schemes.

Intermediate Code Generation: Intermediate Languages- Graphical Representations, Three

address code, Implementations.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain finite state machines for modeling and their power to recognize the languages.
CO2: Summarize the concept of Regular languages and context free languages.
CO3: Construct PDA and Turing machines for the given set of languages.
CO4: Build the lexical and Syntax analyzer phases of compiler.
CO5: Model SDD's using Intermediate Representations.

TEXT BOOKS:

1. John E Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", 3rd Edition, Pearson Education, 2011.
2. Alfred Aho,Monica S Lam, RaviSethi, JeffreyD.Ullman, "Compilers- Principles Techniques and Tool", 2nd Edition, Pearson Education India, 2013.

REFERENCES:

1. Peter Linz, " An introduction to Formal Languages and Automata", 6th Edition, Jones andBartlett, 2016
2. V.Raghavan, "Principles of Compiler Design",1st Edition,McGrawHillEducation,2017.
3. Mishra and Chandrashekaran, "Theory of Computer Science – Automata Languages and Computation", 3rd Edition, PHI, 2009
4. K.V.N.Sunitha , N.Kalyani, "Formal Languages and Automata Theory", 1st Edition, TMH, 2010
5. Michel Sipser, "Introduction to Theory of Computation", 2nd Edition, Thomson, 2012

21CS901 CYBER PHYSICAL SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Understand Cyber Physical System
- To Analyze Intelligent CPS
- To Apply modern tools to develop CPS applications
- To design a Cyber physical system for a given problem
- To test Cyber physical system

UNIT I INTRODUCTION -SYNCHRONOUS MODEL 9

Reactive components - properties of components -composing components -synchronous designs

UNIT II SAFETY REQUIREMENTS 9

Safety Specifications-Verifying Invariants-Enumerative Search-Symbolic Search

UNIT III ASYNCHRONOUS MODEL 9

Asynchronous Processes-Asynchronous Design Primitives-Asynchronous Coordination Protocols

UNIT IV LIVENESS REQUIREMENTS 9

Temporal Logic-Model Checking-Proving Liveness-Dynamical Systems-Continuous-Time Models-Linear Systems - Designing Controllers - Analysis Techniques

UNIT V TIMED MODEL 9

Timing-Based Protocols-Timed Automata-Real-Time Scheduling-EDF Scheduling-Fixed-Priority Scheduling-Hybrid Systems-Hybrid Dynamical Models-Designing Hybrid Systems-Linear Hybrid Automata

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of CPS
CO2: Identify research problems in CPS
CO3: Design cyber physical systems
CO4: Verify the designed cyber physical systems
CO5: Deploy cyber physical systems in practical applications

TEXT BOOK:

1. R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.

REFERENCES:

1. Raj Rajkumar, Dionisio de Niz and Mark Klein, “Cyber-Physical Systems”, Addison-Wesley, 2017
2. Andr´e Platzer. Logical Foundations of Cyber-Physical Systems. Springer, 2018

21CS904 IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts of image processing and pattern recognition
- To understand the basics of image transformation and filtering techniques
- To study image restoration and reconstruction techniques
- To know the fundamentals of color image processing
- To study the various image segmentation methods

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Introduction-Digital Image Processing-origins-Examples-Fundamental steps in DIP-Components of

an Image Processing System-Digital Image Fundamentals-Image Sensing and Acquisition-Image Sampling and Quantization-Introduction to the Basic Mathematical Tools Used in Digital Image

UNIT II INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING 9

Some Basic Intensity Transformation Functions-Histogram Processing-Fundamentals of Spatial Filtering-Smoothing (Lowpass) Spatial Filters-Sharpening (Highpass) Spatial Filters-Highpass, Band reject, and Bandpass Filters from Lowpass Filters-Combining Spatial Enhancement Methods-Filtering in the Frequency Domain-The Discrete Fourier Transform of One Variable -Extensions to Functions of Two Variables-Image smoothing using Lowpass frequency domain filters- Image sharpening using high pass filters- Selective Filtering- The Fast Fourier Transform.

UNIT III IMAGE RESTORATION AND RECONSTRUCTION 9

A Model of the Image Degradation/Restoration process-Noise Models-Restoration in the Presence of Noise Only—Spatial Filtering-Periodic Noise Reduction Using Frequency Domain Filtering -Linear, Position-Invariant Degradations -Estimating the Degradation Function -Inverse Filtering-Minimum Mean Square Error (Wiener) Filtering-Constrained Least Squares Filtering -Geometric Mean Filter -Image Reconstruction from Projections

UNIT IV COLOR IMAGE PROCESSING 9

Color Fundamentals-Color Models-Pseudocolor Image Processing-Basics of Full-Color Image Processing-Color Transformations-Color Image Smoothing and Sharpening-Using Color in Image Segmentation -Noise in Color Images-Color Image Compression-

UNIT V IMAGE SEGMENTATION AND UNDERSTANDING 9

Fundamentals-Point, Line, and Edge Detection-Thresholding-Segmentation by Region Growing and by Region Splitting and Merging-Region Segmentation Using Clustering and Superpixels-Region Segmentation Using Graph Cuts -Segmentation Using Morphological Watersheds -The Use of Motion in Segmentation. Image Pattern Classification- Patterns and Pattern Classes -Pattern Classification by Prototype Matching -Optimum (Bayes) Statistical Classifiers.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Describe the basic concepts of image processing with mathematical interpretation
CO2: Apply the knowledge of different image enhancement, and image registration techniques
CO3: Develop a model for Image Restoration and Degradation using Various Filtering Techniques
CO4: Acquire the concepts of color image processing
CO5: Demonstrate the various image segmentation and morphological operations for partition the objects

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Edition, Pearson, 2018.
2. William K. Pratt, Digital Image Processing, 4th Edition, John Wiley, 2007.

REFERENCES:

1. Maria Petrou and Panagiota Bosdogianni, “Image Processing: The Fundamentals”, 2nd edition, JohnWiley, 2010
2. Kenneth R. Castleman, “Digital Image Processing”, 2nd Edition, Pearson, 2010
3. S.Sridhar, “Digital Image Processing”, 2nd Edition, 2016.

21CS911 HIGH PERFORMANCE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of Modern processors.
- To analyze the various optimization techniques for writing parallel high-performance applications.
- To discuss the basics of Parallel computers.
- To learn shared memory parallel programming using OpenMP.
- To understand the distributed memory parallel programming with MPI.

UNIT I MODERN PROCESSORS 9

Stored Program Computer Architecture - General purpose cache- based microprocessor- Performance based metrics and benchmarks- Moore's Law- Pipelining- Superscalarity - SIMD- Memory Hierarchies - Cache- mapping- prefetch- Multicore processors- Mutithreaded processors- Vector Processors- Design Principles- Maximum performance estimates- Programming for vector architecture.

UNIT II OPTIMIZATION TECHNIQUES 9

Basic optimization techniques for serial code : scalar profiling - function and line based runtime profiling- hardware performance counters- common sense optimizations- elimination of common subexpressions- avoiding branches - using SIMD instruction sets- the role of compilers - C++ optimizations - data access optimization: balance analysis and light speed estimates- storage order- Case study: jacobi algorithm and dense matrix transpose.

UNIT III PARALLEL COMPUTERS 9

Taxonomy of parallel computing paradigms - Shared memory computers - Distributed-memory computers- Hierarchical systems- Networks - Basics of parallelization – Need to parallelize - Parallelism - Parallel Scalability- Factors that limit parallel execution- Scalability metrics- Simple scalability laws- parallel efficiency - serial performance Vs Strong scalability- Load balance.

UNIT IV SHARED MEMORY PARALLEL PROGRAMMING WITH OpenMp 9

Introduction to Open MP - parallel execution - data scoping- OpenMp work sharing for loops- synchronization - reductions - loop scheduling - tasking - case study: OpenMp-parallel jacobi algorithm - Efficient OpenMP programming: Profiling OpenMP programs - Performance pitfalls.

UNIT V DISTRIBUTED MEMORY PARALLEL PROGRAMMING WITH MPI 9

Message passing - introduction to MPI – example - messages and point-topoint communication - collective communication – nonblocking point-to-point communication- virtual topologies - MPI parallelization of Jacobi solver- MPI implementation - performance properties - Basic MPI/OpenMP programming models.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of Modern processors.

CO2: Analyze the various optimization techniques for writing parallel high performance applications.

CO3: Discuss the basics of Parallel computers.

CO4: Learn shared memory parallel programming using OpenMP.
CO5: Understand the distributed memory parallel programming with MPI.

TEXT BOOK:

1. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing for Scientists and Engineers, Chapman and Hall / CRC Computational Science series, 2011.

REFERENCES:

1. Robert Robey and Yuliana Zamora, Parallel and High Performance Computing, Manning Publications, 2021.
2. Thomas Sterling, Matthew Anderson, Maciej Brodowicz, High Performance Computing: Modern Systems and Practices, Morgan Kaufmann Publishers, 2018.

21CS912	MULTI-CORE ARCHITECTURES AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms,
- To develop multi core programs
- To design parallel solutions.

UNIT I MULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP 9

Compiling and running OpenMP programs,The Trapezoidal rule,The parallel for directive, scheduling loops- Producers and consumers .

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation.

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Describe multicore architectures and identify their characteristics and challenges
CO2: Identify the issues in programming Parallel Processors
CO3: Write programs using OpenMP and MPI.
CO4: Design parallel programming solutions to common problems.
CO5: Compare and contrast programming for serial processors and programming for parallel processors.

TEXT BOOKS:

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kauffman/Elsevier, 2011.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011.

REFERENCES:

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw

Hill,2003.
2. Victor Alessandrini, “Shared Memory Application Programming Concepts and Strategies in Multicore Application Programming, ”, 1st Edition, Morgan Kaufmann, 2015.
3. Yan Solihin, “Fundamentals of Parallel Multicore Architecture”, CRC Press, 2015.

21CS913	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of the Internet of Things.
- To discuss the IoT topologies and types.
- To learn about the basics of IOT protocols.
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels and Deployment Templates - Domain Specific IoTs - IoT and M2M

UNIT II EVOLUTION OF IoT 9

Emergence of IoT – IoT versus M2M, IoT versus CPS, IoT versus WoT, IoT Sensing and Actuation –sensor characteristics, sensing types, actuator characteristics, types, IoT Processing Topologies and Types

UNIT III IoT PROTOCOLS 9

IoT Connectivity Technologies –IEEE 802.15.4,Zigbee,Thread,Z-wave,wirelessHART,IoT Communication Technologies: Introduction – Infrastructure protocols – IPv6,RPL,QUIC,Micro internet protocol, Discovery protocols – Data protocols -MQTT,AMQP,XMPP, Identification protocols – Device management – Semantic protocols

UNIT IV BUILDING IoT WITH RASPBERRY PI and ARDUINO 9

Logical Design using Python – IoT Physical Devices and Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Devices - Arduino.

UNIT V IoT AND FUTURE TRENDS 9

Agricultural IoT - Vehicular IoT - Healthcare IoT – Paradigms, challenges and future.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand the fundamentals of Internet of Things.
- Understand the significance of evolution of IoT topologies and types.
- Analyze various protocols for IoT.
- Design a portable IoT using Rasperry Pi.
- Analyze applications of IoT in real time scenario.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Sudip Misra, Anandarup Mukherjee, Arjit Roy, “Introduction to IoT”, Cambridge University Press, 2021.

REFERENCES:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, CISCO Press, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

3. Srinivasa K.G., Siddesh G.M., Hanumantha Raju R., "Internet of Things", Cengage Learning India Pvt Ltd, First Edition, 2018.
4. Mohammed A. Matin, "Wireless Sensor Networks: Technology and Protocols", InTech, 2012.
5. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
6. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
7. Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.

21CS501 COMPUTER NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the fundamental concepts of computer networks and physical layer.
- To gain the knowledge of various protocols and techniques used in the data link layer.
- To learn the services of network layer and network layer protocols.
- To describe different protocols used in the transport layer.
- To understand the application layer protocols.

UNIT I INTRODUCTION AND PHYSICAL LAYER 9

Data Communications – Network Types – Protocol Layering – Network Models (OSI, TCP/IP) Networking Devices: Hubs, Bridges, Switches – Performance Metrics – Transmission media - Guided media -Unguided media- Switching-Circuit Switching - Packet Switching.

UNIT II DATA LINK LAYER 11

Introduction – Link-Layer Addressing- Error Detection and Correction - DLC Services – Data Link Layer Protocols – HDLC – PPP - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth

UNIT III NETWORK LAYER 9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

UNIT IV TRANSPORT LAYER 8

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT V APPLICATION LAYER 8

Application layer-WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the fundamental concepts of computer networks and physical layer.
CO2: Gain knowledge of various protocols and techniques used in the data link layer.
CO3: Learn the network layer services and network layer protocols.
CO4: Understand the various protocols used in the transport layer.
CO5: Analyze the various application layer protocols.

TEXTBOOK:

1. Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2017.

REFERENCES:

1. Computer Networking- A Top Down Approach, James F. Kurose, University of

Massachusetts and Amherst Keith Ross, 8th Edition, 2021.
2. Computer Networks, Andrew S. Tanenbaum, Sixth Edition, Pearson, 2021.
3. Data Communications and Computer Networks, P.C. Gupta, Prentice-Hall of India, 2006.
4. Computer Networks: A Systems Approach , L. L. Peterson and B. S. Davie, Morgan Kaufmann, 3rd ed., 2003.

21CS917 DATA SCIENCE FUNDAMENTALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the fundamentals of data science
- To experiment and implement python libraries for data science
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization tools in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II PYTHON LIBRARIES FOR DATA SCIENCE 9

Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands - The Basics of NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance Pandas.

UNIT III CLASSIFICATION 9

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.
Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

UNIT IV CLUSTERING AND OUTLIER DETECTION 9

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Base map - Visualization with Seaborn.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the fundamentals of data science

CO2: Experiment python libraries for data science

CO3: Apply and implement basic classification algorithms

CO4: Implement clustering and outlier detection approaches

CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017

REFERENCES:

1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017
4. Avrim Blum, John Hopcroft, Ravi Kannan, "Foundations of Data Science", 1st Edition, Cambridge University Press, 2020.

21CS929	GOOGLE CLOUD COMPUTING FOUNDATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the different ways a user can interact with Google Cloud.
- To discover the different compute options in Google Cloud and implement a variety ofstructured and unstructured storage models.
- To confer the different application managed service options in the cloud and outline how security in the cloud is administered in Google Cloud.
- To demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.
- To determine a variety of managed big data services in the cloud.

UNIT I INTRODUCTION TO GOOGLE CLOUD 9

Cloud Computing - Cloud Versus Traditional Architecture - IaaS, PaaS, and SaaS - Google Cloud Architecture - The GCP Console - Understanding projects - Billing in GCP - Install and configure Cloud SDK - Use Cloud Shell - GCP APIs - Cloud Console Mobile App.

UNIT II COMPUTE AND STORAGE 9

Compute options in the cloud - Exploring IaaS with Compute Engine - Configuring elastic apps with autoscaling - Exploring PaaS with App Engine - Event driven programs with Cloud Functions - Containerizing and orchestrating apps with Google Kubernetes Engine - Storage options in the cloud - Structured and unstructured storage in the cloud - Unstructured storage using Cloud Storage - SQL managed services - Exploring Cloud SQL - Cloud Spanner as a managed service - NoSQL managed service options - Cloud Datastore, a NoSQL document store - Cloud Bigtable as a NoSQL option.

UNIT III APIs AND SECURITY IN THE CLOUD 9

The purpose of APIs - Cloud Endpoints - Using Apigee Edge - Managed message services - Exploring Cloud SQL - Cloud Pub/Sub - Introduction to security in the cloud - The shared

security model - Encryption options - Authentication and authorization with Cloud IAM - Identify Best Practices for Authorization using Cloud IAM.

UNIT IV NETWORKING, AUTOMATION AND MANGAEMENT TOOLS 9

Introduction to networking in the cloud - Defining a Virtual Private Cloud - Public and private IP address basics - Google's network architecture - Routes and firewall rules in the cloud - Multiple VPC networks - Building hybrid clouds using VPNs, interconnecting, and direct peering - Different options for load balancing - Introduction to Infrastructure as Code - Cloud Deployment Manager - Public and private IP address basics - Monitoring and managing your services, applications, and infrastructure - Stackdriver.

UNIT V BIG DATA AND MACHINE LEARNING SERVICES 9

Introduction to big data managed services in the cloud - Leverage big data operations with Cloud Dataproc - Build Extract, Transform, and Load pipelines using Cloud Dataflow - BigQuery, Google's Enterprise Data Warehouse - Introduction to machine learning in the cloud - Building bespoke machine learning models with AI Platform - Cloud AutoML - Google's pre-trained machine learning APIs.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Describe the different ways a user can interact with Google Cloud.

CO3: Discover the different compute options in Google Cloud and implement a variety of structured and unstructured storage models.

CO3: Discuss the different application managed service options in the cloud and outline how security in the cloud is administered in Google Cloud.

CO4: Demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.

CO5: Discover a variety of managed big data services in the cloud.

REFERENCES:

1. https://cloud.google.com/docs
2. https://www.cloudskillsboost.google/course_templates/153
3. https://nptel.ac.in/courses/106105223

21CS924 GAME THEORY AND PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain game programming fundamentals.
- To learn about the processes, mechanics, issues in game design.
- To gain knowledge of the game design and Artificial intelligence.
- To understand the design and scripting languages of game programming.
- To know about networked games and analyse code for sample games.

UNIT I INTRODUCTION 9

Evolution of video game programming-The Game Loop-Time and games-Game objects-2D rendering Foundations-Sprites-Scrolling-Tile Maps-Vectors –Matrices

UNIT II 3D GRAPHICS FOR GAMES 9

3D graphics-Basics-Coordinate-spaces-Lighting and Shading-visibility-Input Devices-Event based input system-Mobile Input-Basic sound-3D sound-Digital Signal Processing-Physics-Planes, Rays, and line segments-Collision Geometry-Collision Detection-Physics base movement-Physics middleware.

UNIT III GAME DESIGN AND AI 9

Cameras-Types of cameras-Perspective projection-Camera implementation-Camera support algorithm- Real AI versus Game AI-Pathfinding-State based behaviours-Strategy and planning.

UNIT IV USER INTERFACE AND SCRIPTING LANGUAGES 9

Menu system-HUD elements-Radar-other UI considerations-Scripting Languages-Implementing a scripting language-Tokenization-Syntax Analysis-Code Execution or Generation-Data Formats-Case study UI mods in world of warcraft.

UNIT V NETWORKED GAMES 9

Protocols-Network Topology-Server/Client-Peer-to-Peer-Cheating-Sample game -Side scroller for iOS, Tower defense for PC/Mac-Code Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the essential 2D graphical and mathematical techniques for game programming.
CO2: Illustrate 3D graphics like coordinate spaces, lighting and shading, z-buffering, and quaternions
CO3: Apply artificial intelligence techniques in game design.
CO4: Construct a basic game engine using UI and scripting languages.
CO5: Develop code for sample games.

TEXT BOOK:

1. Sanjay Madhav, Game Programming Algorithms and Techniques:A platform -Agnostic Approach-Game Design,1st Edition, Addison-Wesley Professional,2013**.**

REFERENCES:

1. JouniSmed, HarriHakonen, Algorithms and Networking for Computer Games, 2nd Edition, Wiley Publications, 2017.
2. Ernest Adams and Andrew Rollings, “Fundamentals of Game Design”, Prentice Hall 3rd Edition, 2014.
3. JungHyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 1st Edition, 2011.

21CS403 INTERNET PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand different internet technologies and to design website using HTML and CSS
- To build dynamic webpages
- To create server-side programs using JSP and Servlets
- To construct simple web pages in PHP and to represent data in XML format.
- To demonstrate Java-specific web services

UNIT I WEBSITE BASICS, HTML 5, CSS 3 9

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text –

Transformations – Transitions – Animations.

UNIT II CLIENT SIDE PROGRAMMING 9

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,-Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files – Http Request – SQL.

UNIT III SERVER SIDE PROGRAMMING 9

Servlets: Java Servlet Architecture - Servlet Life Cycle - Parameter Data - Session Handling- Understanding Cookies - Installing and Configuring Apache Tomcat Web Server - DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages - JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.

UNIT IV PHP and XML 9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database. XML: Basic XML- Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

UNIT V INTRODUCTION TO AJAX and WEB SERVICES 9

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP – REST based web services – Introduction to Java Web Development Frameworks.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Construct a basic website using HTML and Cascading Style Sheets.
CO2: Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
CO3: Develop server side programs using Servlets and JSP.
CO4: Construct simple web pages in PHP and to represent data in XML format.
CO5: Apply AJAX and web services to develop interactive web applications

TEXT BOOKS:

1. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Pearson, 5th Edition, 2018.
2. Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”, Pearson Education, 2011.

REFERENCES:

1. Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, 2nd Edition, 1999.
2. Chris Bates, “Web Programming – Building Intranet Applications”, 3rd Edition, Wiley Publications, 2009.
3. Gopalan N.P. and Akilandeswari J., “Web Technology”, Second Edition, Prentice Hall of India, 2014.
4. Uttam K.Roy, “Web Technologies”, Oxford University Press, 2011.
5. Nicholas S. Williams, Professional Java for Web Applications, Wrox Publisher, First Edition, 2014.

		L	T	P	C
21CS602	**CRYPTOGRAPHY AND NETWORK SECURITY**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the fundamentals of network security and security architecture.
- To learn the different symmetric key cryptographic algorithms.
- To study the various asymmetric key cryptographic algorithms and techniques.
- To know the importance of message authentication and integrity.
- To learn the various security practices and system security mechanisms.

UNIT I INTRODUCTION **9**

Security trends - Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography-

UNIT II SYMMETRIC KEY CRYPTOGRAPHY **9**

MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid‟s algorithm- Congruence and matrices.

SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard.

UNIT III PUBLIC KEY CRYPTOGRAPHY **9**

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler‘s totient function - Chinese Remainder Theorem – Exponentiation and Algorithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT IV RUN-TIME ENVIRONMENT AND CODE GENERATION **9**

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - X.509

UNIT V SECURITY PRACTICE AND SYSTEM SECURITY **9**

Electronic Mail security – PGP– IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the different phases of compiler

CO2: Perform tokenization and parsing for programs

CO3: Generate intermediate code representation for any source programs

CO4: Analyze the different techniques used for assembly code generation

CO5: Implement code optimization techniques with simple code generators

TEXT BOOK:

1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson education 8th Edition, 2020.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd 1st Edition,2011
2. Behrouz A.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Wade Trappe, Lawrence C. Washington: Introduction to Cryptography with Coding Theory, 3rd Edition, 2020.

21IT917	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the importance of roots of knowledge system.
- Make the students understand the traditional knowledge and analyse it and apply it to their day-to-day life.

UNIT I INTRODUCTION TO TRADITIONAL KNOWLEDGE 9

Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.

UNIT II PROTECTION OF TRADITIONAL KNOWLEDGE 9

The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III LEGAL FRAMEWORK AND TK 9

The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

UNIT IV TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY 9

Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

UNIT V TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS 9

Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Illustrate the concepts of Indian traditional knowledge.

CO2: Apply the concept of protection of traditional knowledge.
CO3: Analyze the legal framework and traditional knowledge.
CO4: Interpret the concept of traditional knowledge and intellectual property.
CO5: Analyze and apply traditional knowledge to their day-to-day life.

TEXT BOOK:

1. Amit Jha, Traditional Knowledge System in India, Atlantic Publishers, 2002.

REFERENCES:

1. Kapil Kapoor, Michel Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.

21CS937	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

Students completing this course are expected to:

- Understand the roles of Management and the principles of an organization.
- Discuss the functions and responsibilities of managers.
- Demonstrate the tools and techniques to be used in the performance of the managerial job.
- Analyze and understand the environment of the organization.
- Develop the cognizance of the importance of management principles.

UNIT 1 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. Fundamentals of Entrepreneurship, Circular flow of income.

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 - strategic technology planning

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority–departmentalization–delegation of authority– centralization and decentralization–Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management ,Career planning and management. Managing personnel records

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. Organizational behaviour

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 .SQC techniques

TOTAL: 45 PERIODS

OUTCOMES:

After successful completion of the course, the students will be able to:

CO1: Understand the management thoughts and various challenges of managerial activities in a global business environment.
CO2: Demonstrate the various strategies in Decision making at various levels management in the Organizations.
CO3: Discuss the various types of Organization structure.

CO4: Describe the steps in Staffing process and stages in Career development.
CO5: Explain the elements in Direction.
CO6: Summarize the various Controlling techniques to maintain standards in Organizations.

TEXT BOOKS:

1. Koontz, H, and Weihrich, H, "Essentials of Management: An International Perspective", (8th ed.), Tata McGraw Hills, New Delhi, 2016.
2. Ghuman, K and Aswathapa, K, "Management concepts and cases", Tata McGraw Hills, 10th edition , New Delhi, 2017.
3. Telsan, M.T., "Industrial and Business Management, S. Chand, 4th edition , New Delhi, 2016.

REFERENCES:

1. Robbins, S., "Management", 13th edition, Pearson Education, New Delhi, 2017.
2. Saxena, P.K., "Principles of Management: A Modern Approach", Global India Publications, 2016.

SEMESTER VII – PROFESSIONAL ELECTIVE – IV / V /VI

		L	T	P	C
21AM912	**ROUGH SETS AND FUZZY SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To help students to be familiar with the fundamental concepts of fuzzy set theory and fuzzy logic.
- To foster competence in recognizing the feasibility and applicability of the design and implementation of intelligent systems (that employ fuzzy logic) for specific application areas.
- To help students develop a sufficient understanding of fuzzy system design methodology and how it impacts system design and performance.

UNIT I CLASSICAL SETS AND FUZZY RELATIONS 9

Crisp set theory (CST): Introduction, Relations between sets, Operations on sets, Characteristic functions, Cartesian products of crisp sets, crisp relations on sets. Fuzzy set theory (FST): Introduction, concept of fuzzy set (FS), Relation between FS, operations on FS, properties of standard operations, certain numbers associated with a FS, certain crisp sets associated with FS, Certain FS associated with given FS, Extension principle.

UNIT II FUZZIFICATION AND DEFUZZIFICATION 9

Fuzzification and Defuzzification: Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - Lambda cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation.

UNIT III FUZZY SYSTEMS 9

Fuzzy Systems: Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

UNIT IV FUZZY DECISION MAKING 9

Fuzzy decision making: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions.

UNIT V FUZZY CLASSIFICATION 9

Fuzzy Classification: Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.

CO2: Understand the basic features of membership functions, fuzzification process and defuzzification process.
CO3: Design fuzzy rule-based system.
CO4: Know about combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decision-making process.
CO5: Gain the knowledge about fuzzy C-Means clustering.

TEXT BOOKS:

1. Timothy J.Ross, "Fuzzy logic with engineering applications", 3rd edition, Wiley,2010.
2. George J.KlirBo Yuan, "Fuzzy sets and Fuzzy logic theory and Applications", PHI, New Delhi,1995.

REFERENCES:

1. S.Rajasekaran, G.A.Vijayalakshmi, "Neural Networks and Fuzzy logic and Genetic Algorithms, Synthesis and Applications", PHI, New Delhi,2003.
2. L. X. Wang, "A Course in Fuzzy Systems and Control", Prentice-Hall, 1997.
3. K. M. Passino, "Fuzzy Control", Addison-Wesley, 1998.
4. George J Klir; Ute H St Clair; Bo Yuan," Fuzzy set theory : foundations and applications", Prentice Hall, 1997.
5. Jan Jantzen, "Foundation of Fuzzy Control: A Practical approach", Willey, 2013.

21AM913	SEMANTIC WEB	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of semantic web and to conceptualize and depict Ontology for semantic web.
- To understand the languages for semantic web.
- To learn about the ontology learning algorithms and to utilize in the development of an application.
- To know the fundamental concepts of ontology management.
- To learn the applications related to semantic web.

UNIT I THE QUEST FOR SEMANTICS 9

Building Models – Calculating with Knowledge – Exchanging Information – Semantic Web Technologies – Layers – Architecture – Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background – Sample Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation.

UNIT II LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES 9

Web Documents in XML – RDF – Schema – Web Resource Description using RDF – RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics – Traditional Ontology Languages – LOOM – OKBC – OCML – Flogic Ontology Markup Languages – SHOE – OIL – DAML+OIL – OWL.

UNIT III ONTOLOGY LEARNING FOR SEMANTIC WEB 9

Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning –Importing and Processing Ontologies and Documents – Ontology Learning Algorithms –Methods for evaluating Ontologies.

UNIT IV ONTOLOGY MANAGEMENT AND TOOLS 9

Overview – Need for management – Development process – Target Ontology – Ontology mapping – Skills management system – Ontological class – Constraints – Issues – Evolution –Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools.

UNIT V APPLICATIONS 9

Web Services – Semantic Web Services – Case Study for specific domain – Security issues – Web

Data Exchange and Syndication – Semantic Wikis – Semantic Portals – Semantic Metadata in Data Formats – Semantic Web in Life Sciences – Ontologies for Standardizations – Rule Interchange Format.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Create ontology for a given domain.
: Develop an application using ontology languages and tools.
: Understand the concepts of semantic Web.
CO4: Use ontology related tools and technologies for application creation.
: Design and develop applications using semantic web.
: Understand the standards related to semantic web.

TEXT BOOKS:

1. Pascal Hitzler, Markus Krötzsch, Sebastian Rudolph, "Foundations of Semantic Web Technologies", Chapman and Hall/CRC, 2009.
2. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez, "Ontological Engineering: with Examples from the Areas of Knowledge Management, e-Commerce and the Semantic Web", Springer, 2010.

REFERENCES:

1. Grigoris Antoniou, Frank van Harmelen, "A Semantic Web Primer (Cooperative Information Systems)", MIT Press, 2008.
2. Alexander Maedche, "Ontology Learning for the Semantic Web", First Edition, Springer. 2002.
3. John Davies, Dieter Fensel, Frank Van Harmelen, "Towards the Semantic Web: Ontology Driven Knowledge Management", John Wiley, 2003.
4. John Davies, Rudi Studer, Paul Warren, "Semantic Web Technologies: Trends and Research in Ontology-Based Systems", Wiley, 2006.

21AM914	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basic concepts of Soft Computing.
- To understand artificial neural networks.
- To explain fuzzy systems.
- To explain Genetic Algorithms.
- To discuss the various Hybrid algorithms and various Swarm Intelligence algorithms.

UNIT I INTRODUCTION **9**

Neural Networks - Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing - Artificial Neural Network - Evolution of Neural Networks - Basic Models of ANN – Weights – Bias – Threshold – Learning Rate – Momentum Factor – Vigilance Parameter- McCulloch–Pitts Neuron - Linear Separability - Hebb Network.

UNIT II ARTIFICIAL NEURAL NETWORKS **9**

Perceptron Networks - Adaptive Linear Neuron - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Pattern Association - Autoassociative and Heteroassociative Memory Networks - Bidirectional Associative Memory (BAM) - Hopfield Networks - Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps.

UNIT III FUZZY SYSTEMS **9**

Fuzzy Logic - Classical Sets (Crisp Sets) - Fuzzy Sets – Fuzzy Relation - Features of the Membership Functions - Fuzzification - Methods of Membership Value Assignments - Defuzzification - Lambda-Cuts for Fuzzy Sets (Alpha-Cuts) - Lambda-Cuts for Fuzzy Relations - Defuzzification Methods – Fuzzy Reasoning – Fuzzy Inference Systems.

UNIT IV GENETIC ALGORITHMS **9**

Biological Background - Traditional Optimization and Search Techniques- Genetic Algorithm and Search Space- - Simple GA - General Genetic Algorithm - Operators - Stopping Condition - Constraints - Problem Solving - The Schema Theorem- Classification - Holland Classifier Systems- Genetic Programming - Advantages and Limitations- Applications.

UNIT V HYBRID SOFT COMPUTING AND SWARM INTELLIGENCE ALGORITHMS **9**

Neuro-Fuzzy Hybrid Systems - Genetic Neuro-Hybrid Systems - Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP – Swarm Intelligence Algorithms - Ant Colony Optimization – Artificial Bee Colony – Particle Swarm Optimization – Firefly Algorithm.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basic concepts of Soft Computing
CO2: Artificial neural networks and its applications.
CO3: Fuzzy logic and its applications.
CO4: Solving problems using Genetic algorithms.
CO5: Applications of Soft computing to solve problems in varieties of application domains.

TEXT BOOKS:

1. S. N. Sivanandam , S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2019.
2. Adam Slovik, “Swarm Intelligence Algorithms: Modification and Applications”, Taylor and Francis, First Edition, 2020.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.
2. Kwang H. Lee, First course on Fuzzy Theory and Applications‖, Springer, 2005.
3. N.P. Padhy, S. P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
4. S. Rajasekaran, G. A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.

21AM915 AI IN CYBER SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need of AI in Cyber Security and the detection of DDOS using AI techniques.
- To learn the various techniques of AI to detect cyber-attacks.
- To explore AI techniques to crack CAPTCHA.
- To learn to detect malicious events.
- To learn the intrusion detection using Neural Networks.

UNIT I FUNDAMENTALS OF AI AND DDoS **12**

Introduction – Problems that AI Solves – Why AI in Cyber security – Current Cyber Security Solutions - Structured data, Unstructured data – Supervised learning – Unsupervised learning – Reinforcement learning – classification problem - clustering problems – SVM – ANNs.
Time series – Types of Time series – Time Series analysis in Cyber Security – Detecting DDoS with Time Series – Predicting DDoS attacks – Ensemble Techniques for Cyber security – Types of Ensemble – Types of Ensemble Algorithms – Bagging, Boosting, Stacking, Bayesian Model - Ensemble Method to detect Cyber attack.

UNIT II MALICIOUS WEB PAGES 8

URL Blacklisting – Drive by download URL- Command and Control URLs – Phishing URLs – Using Heuristics to detect Malicious Pages – Data for the analysis – Feature Extraction – Lexical Features – Web Content based Features – Host based features – site Popularity features.

UNIT III CAPTCHA 8

Using AI to crack CAPTCHA – Types of CAPTCHA – ReCAPTCHA – Breaking a CAPTCHA – Solving CAPTCHA with neural network - Machine Learning in Scan Detection - Machine-Learning Applications in Scan Detection

UNIT IV MALICIOUS EVENT DETECTION 8

Context based Malicious event detection – Adware – Bots –Bugs – Ransomeware – Rootkit – Spyware – Trojan horses – Viruses – Worms – Malicious Injections in Wireless networks.

UNIT V IDS AND MAIL SERVER 9

Architecture of IDS based on Neural networks – Intelligent flow based IDS - Multi-Agent IDS – AI based Ensemble IDS – Machine Learning in Hybrid Intrusion Detection Systems - Machine-Learning Applications in Hybrid Intrusion Detection: Anomaly - Misuse Sequence Detection System - Parallel Detection System.
Types of Mail Server – Data Collection from mail server – Naive Bayes theorem to detect spam – Laplace smoothing – Featurization Techniques to covert text based emails to numeric values – Logistic regression to spam filters - Anomaly detection techniques for SMTP and HTTP.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the cyber threats and vulnerabilities.
CO2: Implement AI techniques to detect cyber-attacks..
CO3: Develop new solutions to crack CAPTCHA.
CO4: Detect malicious events.
CO5: Perform intrusion detection using neural networks.

TEXT BOOKS:

1. Hands-On Machine Learning for Cyber Security: Safeguard your system by making your machine intelligence using the python ecosystem, Soma Harder, SinanOzdemir, Packt Publishing Ltd, 2018.
2. The state of the Art in Intrusion Detection System, AI-Sakib Khan Pathan, CRC Press, Taylor and Francis Group, 2014
3. Data Mining and Machine Learning in Cyber Security, SumeetDua and Xian Du, CRC Press, 2011.

REFERENCES:

1. Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011
2. Cryptography and Network security, Behrouz A. Forouzan , DebdeepMukhopadhyay, Mcgraw Hill Education, 2nd Edition, 2011

21AM916 OPTIMIZATION METHODS IN MACHINE LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of different Submodular functions and Associated Ployhedra.
- To discuss Submodularity and its Applications.
- To analyze the various methods of Non-Smooth Convex Optimizations.
- To analyze the various Separable Optimization Problems.
- To discuss the various Submodular minimization methods and optimizations.

UNIT I INTRODUCTION 9

Introduction – Definition – Submodularity – Associated Polyhedra – Polymatroids – Lovasz Extension – Definition – Greedy Algorithm – Links between submodularity and convexity.
Properties of Associated Polyhedra: Support functions – Facial Structure – Positive and Symmetric submodular Polyhedra.

UNIT II SUBMODULARITY 9

Convex and Concave closures of set functions – Structured Sparsity – Convex Relaxation of Combinatorial Penalty – l_q relaxations of submodular penalties – Shaping level sets – Examples and Applications of Submodularity – Cardinality based functions – Cut functions – Set Covers – Flows – Entropies – Spectral functions of submatrices – Best Subset Selection – Matroids.

UNIT III NON-SMOOTH CONVEX OPTIMIZATION 9

Projected Subgradient descent – Ellipsoid Method – Kelly's Method – Analytic Centre Cutting planes – Mirror descent/conditional gradient – Bundle and Simplicial Methods – Proximal Methods – Simplex algorithm for Linear Programming – Active Set Method for Quadratic Programming – Active Set Algorithms for Least-squares Problems.

UNIT IV SEPARABLE OPTIMIZATION PROBLEMS 9

Analysis: Optimality conditions for base polyhedral – Equivalence with submodular function Minimization – Quadratic Optimization Problems – Separable problems on other polyhedra.
Algorithms: Divide-and Conquer algorithm for proximal problems – Iterative algorithms – Exact minimization-Approximate minimization.

UNIT V SUBMODULAR MINIMIZATION AND OPTIMIZATION 9

Minimizers of Submodular Functions – Combinatorial Algorithms – Minimizing Symmetric posimodular functions – Ellipsoid method – Simplex method for Submodular function minimization – Analytic centre cutting planes -Minimum norm point algorithm – Approximate minimization through convex optimization – Special Structure. Maximization with cardinality constraints – Submodular function minimization.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of different Submodular functions and Associated Ployhedra.
CO2: Discuss Submodularity and its Applications.
CO3: Analyze the various methods of Non-Smooth Convex Optimizations.
CO4: Analyze the various Separable Optimization Problems.
CO5: Discuss the various Submodular minimization methods and optimizations.

TEXT BOOKS:

1. Francis Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc., 2013.

REFERENCES:

1. A. Beck, "First-Order Methods in Optimization", MOS-SIAM Series on Optimization, 2017.
2. S. Bubeck, "Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization", 2015.

21AM917 IMAGE AND VIDEO ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of image processing techniques for computer vision and video analysis.
- To learn the techniques used for image pre-processing.
- To discuss the various image Segmentation techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the motion analysis techniques for video analytics.

UNIT I INTRODUCTION 9

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II IMAGE PRE-PROCESSING 9

Pixel brightness transformations - Geometric transformations - Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-spectral images - Local pre-processing in the frequency domain - - Line detection by local pre-processing operators - Detection of corners (interest points) - Detection of maximally stable extremal regions - Image restoration.

UNIT III SEGMENTATION 9

Thresholding - Edge-based segmentation - Region-based segmentation – Matching - Evaluation issues in segmentation - Mean shift segmentation - Active contour models.

UNIT IV OBJECT RECOGNITION 9

Knowledge representation - Statistical pattern recognition - Neural nets - Syntactic pattern recognition - Recognition as graph matching - Optimization techniques in recognition - Fuzzy systems - Boosting in pattern recognition - Random forests - Image understanding control strategies.

UNIT V MOTION ANALYSIS 9

Differential motion analysis methods - Optical flow - Analysis based on correspondence of interest points - Detection of specific motion patterns - Video tracking - Motion models to aid tracking.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of image processing techniques for computer vision and video analysis.
CO2: Explain the techniques used for image pre-processing.
CO3: Learn the various image Segmentation techniques.
CO4: Understand the various Object recognition mechanisms.
CO5: Elaborate on the motion analysis techniques for video analytics.

TEXT BOOKS:

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.

REFERENCES:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011.
2. Caifeng Shan, Fatih Porikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
3. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
4. E. R. Davies, “Computer and Machine Vision”, Fourth Edition, Academic Press,2012.

21AM918 COGNITIVE SCIENCE AND ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain cognitive computing

- To know about design principles and Natural Language Processing.
- To distinguish between Big Data and Cognitive computing.
- To discuss application of cognitive computing in business.
- To illustrate various applications of cognitive computing.

UNIT I FOUNDATIONS OF COGNITIVE SCIENCE 9

Foundation of Cognitive Computing: cognitive computing as a new generation- the uses of cognitive systems- system cognitive- gaining insights from data- Artificial Intelligence as the foundation of cognitive computing- understanding cognition.

UNIT II DESIGN PRINCIPLES FOR COGNITIVE SYSTEMS AND NLP IN COGNITIVE SYSTEMS 9

Components of a cognitive system- building the corpus- bringing data into cognitive system- machine learning- hypotheses generation and scoring- presentation and visualization services.

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system- semantic web- Applying Natural language technologies to Business problems.

UNIT III BIG DATA Vs COGNITIVE COMPUTING 9

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data- defining big data- architectural foundation- analytical data warehouses- Hadoop- data in motion and streaming data- integration of big data with traditional data.

UNIT IV THE BUSINESS IMPLICATIONS OF COGNITIVE COMPUTING 9

Preparing for change- advantages of new disruptive models- knowledge meaning to business- difference with a cognitive systems approach- meshing data together differently- using business knowledge to plan for the future- answering business questions in new ways- building business specific solutions- making cognitive computing a reality- cognitive application changing the market- IBM Watson as a cognitive system.

UNIT V APPLICATIONS OF COGNITIVE COMPUTING 9

Build a cognitive health care application- Build a cognitive application on Smarter cities-Applicate Cognitive Computing principle in building an Government related application.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain cognitive computing.
CO2: Understand the design principles and learn about NLP in cognitive computing
CO3: Apply advanced analytics to cognitive computing.
CO4: Discuss application of cognitive computing in business
CO5: Illustrate various applications of cognitive computing.

TEXT BOOKS:

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive computing and Big Data Analytics” , Wiley, 2015.

REFERENCES:

1. Vijay Raghvan, Venu Govindaraju, C.R. Rao, “Cognitive Computing: Theory and Applications“, Elsevier publications, North Holland Publication, 1st Edition, 2016.
2. Mallick, Pradeep Kumar, Borah, Samarjeet, "Emerging Trends and Applications in Cognitive Computing”, IGI Global Publishers, 2019.

21AM919 INTELLIGENT AGENT TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To brief on Agents, Multi agents and Intelligent agents
- To explain on Multi agent systems
- To understand the various search algorithms for agents

- To understand Rational Decision Making and Learning in multi agent systems
- To implement an Intelligent agent systems

UNIT I INTRODUCTION 9

Intelligent Agents – Agents – Abstract Architectures- Purely Reactive Agents – Perception – Agents with State – Concrete Architectures – Logic-based architectures – Reactive Architectures – Belief-Desire-Intention Architectures – Layered Architectures – Agent Programming Languages.

UNIT II MULTIAGENT SYSTEMS 9

Characteristics of Multiagent Environments – Agent Communications – Agent Interaction Protocols: Coordination Protocol – Cooperation Protocol – Contract Net – Blackboard Systems – Negotiation – Multiagent Belief Maintenance – Market Mechanisms – Societies of Agents.

UNIT III SEARCH ALGORITHMS FOR AGENTS 9

Constraint Satisfaction Problem – Filtering Algorithm – Hyper-Resolution-based Consistency Algorithm – Asynchronous Backtracking – Asynchronous weak commitment search – Path-Finding Problem: Asynchronous Dynamic Programming – Learning Real-time A* - Real-time A* - Moving Target Search – Real-time Bidirectional Search - Real-time Multiagent Search – Two-player Games – Min-max procedure – Alpha-Beta Pruning.

UNIT IV RATIONAL DECISION MAKING AND LEARNING 9

Evaluation Criteria – Voting – Auctions – Bargaining – Market Mechanisms – Contract Nets – Coalition Formation - Principal Categories – Differencing Features – Credit-Assignment Problem – Learning and Activity Coordination – Learning about and from other agents – Learning and Communication.

UNIT V IMPLEMENTING AGENT SYSTEMS 9

Agent Platforms – JACK – Agents – Capabilities -Data – Message/Events – Plans – Automatic Generation of Skeleton Code.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Brief on Agents, Multi agents and Intelligent agents
CO2: Elaborate on Multi agent systems
CO3: Understand the various search algorithms for agents
CO4: Understand Rational Decision Making and Learning in multi agent systems
CO5: Implement an Intelligent agent systems

TEXT BOOKS:

1. Gerhard Weiss, “Multiagent Systems : A Modern Approach to Distributed Artificial Intelligence”, MIT Press, 2001.
2. Lin Padgham, Michael Winikoff, “Developing Intelligent Agent Systems – A practical Guide”, Wiley, 2004.

REFERENCES:

1. 1. Jeffrey M Bradshaw, "Software Agents", The MIT Press, 2010.
2. Michael Wooldridge, "An Introduction to Multi Agent Systems", second edition, John Wiley and Sons ltd., 2009.
3. Yoav Shoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game theoretic and Logical foundations", Cambridge, 2008.
4. Tomas Salamon, 'Design of Agent Based Models: Developing Computer Simulations for a better understanding of social Processes", Academic series, 2011

21AM920 MACHINE LEARNING FOR BIOINFORMATICS

L	TP	C
3	0 0	3

OBJECTIVES:

- To understand the basics of molecular biology.
- To explore the challenges in bioinformatics.
- To learn the current techniques in machine learning for bioinformatics.
- To study the genetic algorithms.
- To learn the future techniques in machine learning for bioinformatics.

UNIT I BASICS OF MOLECULAR BIOLOGY 6

Basic cell architecture - The structure, content and scale of deoxyribonucleic acid (DNA) - History of the human genome - Genes and proteins- Current knowledge and the 'central dogma' - Why proteins are important - Gene and cell regulation

UNIT II PROBLEMS AND CHALLENGES IN BIOINFORMATICS 6

Genome - Transcriptome – Proteome- Interference technology, viruses and the immune system

UNIT III CURRENT TECHNIQUES 9

Probabilistic approaches-Nearest neighbor and clustering approaches-Identification trees-neural networks.

UNIT IV GENETIC ALGORITHMS 12

Single objective – method,examples-multi objective – method,examples – bioinformatics applications

UNIT V FUTURE TECHNIQUES 12

Genetic Programming-Cellular Automata-Hybrid Methods

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1:Understand the basics of molecular biology.
CO2: Understand the problems and challenges in bioinformatics.
CO3:Implement the current approaches in bioinformatics applications.CO4: Understand the Genetic algorithms.
CO5: Understand the methodology of future techniques in bioinformatics.

TEXT BOOKS:

1. Keedwell, Edward, and Ajit Narayanan. Intelligent bioinformatics: The application of artificialintelligence techniques to bioinformatics problems. John Wiley and Sons, 2005.
2. Bioinformatics and Functional Genomics (2nd edition) by Jonathan Pevsner, Wiley-Liss, ISBN#978-0-470-08585-1.

REFERENCES:

1. Structural Bioinformatics (2nd Edition), Jenny Gu (Editor), Philip E. Bourne (Editor)
2. Lesk, A.M. 2005, 2nd edition, Introduction to Bioinformatics. Oxford University Press.

21AM921 COMPUTATIONAL INTELLIGENCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Study about the introduction of Computational Intelligence.
- To Explore the various Evolutionary Algorithms
- To learn about the fundamental of Neural network
- To learn about the Fuzzy systems
- To study about the Computational Intelligence

UNIT I INTRODUCTION 9

Neural Networks-Fuzzy Logic-Computational Intelligence- Application areas- Adaptation-

Adaptation VS Learning- Types-Spaces-Self Organization and Evolution-Adaptation and Self Organization-Comparison.

UNIT II EVOLUTION OF COMPUTATION CONCEPTS 9

History of Evolutionary Computation- Evolutionary Computation Overview-Genetic Algorithms-Evolutionary Programming-Evolution Strategies-Genetic Programming-Particle Swarm Optimization-Genetic Algorithm Implementation-Particle Swarm Optimization Implementation

UNIT III NEURAL NETWORKS 9

Neural Network History-Neural Network Terminology-Neural Network Topologies-Neural Network Adaptation-Comparing Neural networks and other classification models-Pre-Processing-Post Processing

UNIT IV FUZZY SYSTEM CONCEPTS 9

Fuzzy sets and Fuzzy Logic –Theory of Fuzzy Sets-Approximate Reasoning- Developing a Fuzzy Controller-Fuzzy System Implementation.

UNIT V COMPUTATIONAL INTELLIGENCE IMPLEMENTATIONS 9

Implementation Issues-Fuzzy Evolutionary Fuzzy Rule System Implementation –Choosing Best Tools-An Example Data Mining Systems-Performance Metrics.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Able to Understand the need of Computational Intelligence and its components.
CO2: Analyse the implementation of different algorithms.
CO3: Able to Understand the Neural Network Classification Models.
CO4: To be familiar with Fuzzy sets and its implementation.
CO5: To design and implement the Computational intelligence.

TEXT BOOKS:

1. Dr.Russell Eberhart and Dr.Yuhui Shi, "Computational Intelligence: Concepts to Implementations", Morgan Kaufmann Publishers, 2007.
2. Konar A, "Computational Intelligence: Principles, Techniques and Applications", Springer Verlag, 2005.

REFERENCES:

1. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", Wiley Publishing, 2007.
2. Leszek Rutkowski, "Computational Intelligence: Methods and Techniques", Springer, 2005.

21AM922 DATA AND INFORMATION SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Cryptography
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology

UNIT I INTRODUCTION 9

An Overview of Computer Security - Security Services - Security Mechanisms-Security Attacks-Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies.

UNIT II CRYPTOSYSTEMS and AUTHENTICATION 9

Classical Cryptography - Substitution Ciphers - permutation Ciphers - Block Ciphers – DES - Modes of Operation – AES - Linear Cryptanalysis, Differential Cryptanalysis - Hash Function - SHA 512 - Message Authentication Codes - HMAC - Authentication Protocols.

UNIT III PUBLIC KEY CRYPTOSYSTEMS 9

Introduction to Public key Cryptography- Number theory- The RSA Cryptosystem and Factoring Integer- Attacks on RSA-The EL Gamal Cryptosystem- Digital Signature Algorithm-Finite Fields-Elliptic Curves Cryptography- Key management – Session and Interchange keys, Key exchange and generation-PKI.

UNIT IV SYSTEM IMPLEMENTATION 9

Design Principles, Representing Identity, Access Control Mechanisms, Information Flow and Confinement Problem.

Secure Software Development: Secured Coding - OWASP/SANS Top Vulnerabilities – Buffer Overflows - Incomplete mediation - XSS - Anti Cross Site Scripting Libraries - Canonical Data Format - Command Injection - Redirection - Inference – Application Controls.

UNIT V NETWORK SECURITY 9

Secret Sharing Schemes-Kerberos- Pretty Good Privacy (PGP)-Secure Socket Layer (SSL)-Intruders – HIDS- NIDS - Firewalls – Viruses.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Implement basic security algorithms required by any computing system.

CO2: Analyze the vulnerabilities in any computing system and hence be able to design a security solution.

CO3: Analyze the possible security attacks in complex real time systems and their effective countermeasures

CO4: Identify the security issues in the network and resolve it.

CO5: Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modelling, and simulations.

TEXT BOOKS:

1. William Stallings, “Cryptography and Network Security: Principles and Practices”, Seventh Edition, Pearson Education, 2017.
2. Matt Bishop,“Computer Security art and science”, Second Edition, Addison-Wesley Professional, 2019.

REFERENCES:

1. Wade Trappe and Lawrence C. Washington, “Introduction to Cryptography with Coding Theory” Second Edition, Pearson Education, 2007
2. Jonathan Katz, and Yehuda Lindell, Introduction to Modern Cryptography, CRC Press, 2007
3. Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman and Hall/CRC, 2006
4. Wenbo Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, First Edition, 2006.
5. Network Security and Cryptography, Menezes Bernard, Cengage Learning, New Delhi, 2011
6. Man Young Rhee, Internet Security, Wiley, 2003
7. OWASP top ten security vulnerabilities: http://xml.coverpages.org/OWASP-TopTen.pdf

21AM923	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposure on Augmented Reality.
- To introduce Virtual Reality and input and output devices.
- To acquire knowledge on computing architectures and modelling.
- To explore Virtual Reality programming and human factors.
- To learn various applications of Virtual Reality.

UNIT I AUGMENTED REALITY (AR) 9

Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices.

UNIT II INTRODUCTION TO VIRTUAL REALITY (VR) AND INPUT AND OUTPUT DEVICES 9

Introduction: The three I's of Virtual Reality - - Early commercial VR technology - The five classic components of a VR system. Input devices: Three-Dimensional position trackers - tracker performance parameters - ultrasonic trackers - optical trackers - Navigation and manipulation interfaces - gesture interfaces. Output devices: graphics displays - large-volume displays - sound displays.

UNIT III COMPUTING ARCHITECTURES AND MODELING OF A VR SYSTEM 9

Computing architectures for VR: The rendering pipeline - The graphics rendering pipeline - The haptics rendering pipeline - PC graphics architecture - PC graphics accelerators - Graphics benchmarks - Distributed VR architectures - Multipipeline synchronization - Colocated rendering pipelines. Modeling: geometric modeling - kinematics modeling - physical and behavior modelling

UNIT IV VR PROGRAMMING AND HUMAN FACTORS 9

Toolkits and scene graphs - WorldToolKit - Model geometry and appearance - The WTK scene graph - Sensors and action functions - WTK networking - Java 3D - Model geometry and appearance - Java 3D scene graph - Sensors and behaviors - Java 3D networking - WTK and Java 3D performance comparison –Human factors in VR: Methodology and terminology - user performance studies - VR health and safety issues - VR and society

UNIT V APPLICATIONS OF VR 9

Medical Application of VR - Virtual anatomy-Triage and diagnostic - Surgery - VR in education - VR and the Arts - Entertainment applications of VR - military VR applications - Army use of VR - VR applications in the Navy - Air force use of VR - Applications of VR in Robotics - Robot programming - Robot teleoperation

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand Augmented Reality.
CO2: Explore different input and output devices used in Virtual Reality system.CO3:
Model the VRsystem.
CO4: Learn about Google Toolkit's and Scene Graph.
CO5: Apply VR in various fields.

TEXTBOOKS:

1. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles and Practice", AddisonWesley, 2016.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual reality technology", Wiley, Second Edition, 2017.

REFERENCES:

1. Sherman, William R and Craig, Alan B, "Understanding Virtual reality", Elsevier India PrivateLimited, Noida, 2018.
2. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.

21CS903	VULNERABILITY ANALYSIS AND PENETRATION TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the tools that can be used to perform information gathering
- To identify various attacks in various domains of cyber space and to learn about exploits
- To learn about Wireless environment and its Security
- To learn how vulnerability assessment can be carried out by means of automatic tools or manual investigation.
- To learn the vulnerabilities associated with various network applications and database systems.

UNIT I INFORMATION GATHERING, DETECTING VULNERABILITIES 9

Open Source Intelligence Gathering - Port Scanning - Nessus Policies - Web Application Scanning Manual Analysis- Traffic Capturing

UNIT II ATTACKS and EXPLOITS 9

Password Attacks Client-side Exploitation Social Engineering- Bypassing Antivirus Applications- Metasploit Payloads - Open phpMyAdmin -Buffer overflow: Windows and Linux.

UNIT III WIRELESS SECURITY 9

Wired vs. wireless Privacy Protocols - Wireless Frame Generation Encryption Cracking Tools- Wireless DoS Attacks

UNIT IV COMMON VULNERABILITY ANALYSIS OF APPLICATION PROTOCOLS 9

Simple Mail Transfer Protocol- File Transfer Protocol- Trivial File Transfer Protocol-Hyper Text Transmission Protocol- DNS-DHCP-LDAP-SNMP

UNIT V NETWORK VULNERABILITY ANALYSIS and PENETRATION TOOLS AND DATABASE SECURITY 9

Domain Name Server and Dynamic Host Configuration Protocol -Light Weight Directory Access Protocol-Simple Network Management Protocol-Remote Procedural Call

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the tools that can be used to perform information gathering
CO2: Identify various attacks in various domains of cyber space and to learn about exploits
CO3: Understand about Wireless environment and its Security
CO4: Understand how vulnerability assessment can be carried out by means of automatic tools or manual investigation.
CO5: Understand the vulnerabilities associated with various network applications and database system.

TEXT BOOKS:

1. Georgia Weidman, "Penetration Testing: A Hands On Introduction to Hacking", No Startch Press, First Edition 2014.

2. B.Singh, H.Joseph and Abhishek Singh, ”Vulnerability Analysis and Defense for the Internet, Springer, 2008 Edition.

REFERENCES:

1. Rafay Baloch, ”Ethical Hacking and Penetration Testing Guide”,CRC Press, 2015.
2. Dr.Patrick Engebretson, ”The Basics of Hacking and Penetration Testing”,Syngress Publications Elseveir, 2013.
3. Prakhar Prasad, “Mastering Modern Web Penetration Testing“, Packet Publishing, 2016.
4. Gilberto Najera Gutierrez, “Kali Linux Web Penetration Testing Cookbook”, Packt pub., 2016.
5. Robert Svensson, “From Hacking to Report Writing: An Introduction to Security and Penetration Testing”, Apress, 2016.

21CS906	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization ‘s strategic goals.

UNIT I PROJECT EVALUATION AND PROJECT PLANNING 9

Importance of Software Project Management – Activities – Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION 9

Software process and Process Models – Choice of Process models – Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II – a Parametric Productivity Model.

UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT 9

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass and Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

UNIT IV PROJECT MANAGEMENT AND CONTROL 9

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

UNIT V STAFFING IN SOFTWARE PROJECTS 9

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand Project Management principles while developing software

CO2: Obtain adequate knowledge about software process models and software effort estimation techniques

CO3: Estimate the risks involved in various project activities.

CO4: Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.

CO5: Learn staff selection process and the issues related to people management

TEXT BOOKS:

1. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Sixth Edition, Tata McGraw Hill, 2017.

REFERENCES:

1. Roger S. Pressman Bruce R. Maxin, "Software Engineering A Practitioner's Approach", Mc Graw-Hill Education, 8th edition, 2014.
2. Robert K. Wysocki, "Effective Software Project Management", Wiley Publication, 2011.
3. Walker Royce, "Software Project Management", Addison-Wesley, 1998.

21CS907	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To learn various models pertaining to Human Computer Interaction. To be aware of mobile Human Computer Interaction.
- To learn the guidelines for user interface

UNIT I FOUNDATIONS OF HCI 9

Input–output channels, Human memory, thinking reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning.

UNIT II DESIGN SOFTWARE PROCESS 9

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.

UNIT III INTERACTION DESIGN MODELS 9

GOMS - CMN-GOMS Analysis, Modeling Structure, State Transition Networks - Three-State Model, Glimpse Model, Physical Models,– Shneideman's eight golden rules, Norman's Sever principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through.

UNIT IV MOBILE HCI AND WEB INTERFACE DESIGN 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies. Designing Web Interfaces – Drag Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies.

UNIT V COLLABORATION AND COMMUNICATION 9

Face-to-face Communication, Conversation, Text-based Communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog

analysis and design: Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Enumerate the basic concepts of human, computer interactions
CO2: Inspect software design process in human computer interaction
CO3: Examine various models and theories related to human computer interaction
CO4: Build meaningful user interface
CO5: Establish the different levels of communication across the application stakeholders.

TEXT BOOKS:

1. A Dix, Janet Finlay, G D Abowd, R Beale., "Human-Computer Interaction", 3rd Edition, Pearson Publishers, 2008.
2. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009.

REFERENCES:

1. Shneiderman, Plaisant, Cohen and Jacobs, "Designing the User Interface: Strategies for Effective Human Computer Interaction", 5th Edition, Pearson Publishers, 2010.
2. Hans-Jorg Bullinger,"Human-Computer Interaction", Lawrence Erlbaum Associates, Publishers, 1999.
3. Jakob Nielsen," Advances in Human-computer Interaction",Ablex Publishing Corporation, 1995.

21CS910 SOCIAL NETWORK ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To outline the components of the social network.
- To explain the modeling and visualization of the social network.
- To classify descriptive and inferential methods.
- To discuss about the evolution of the social network.
- To illustrate the applications in real time systems.

UNIT I INTRODUCTION **9**

Basics of Social Network Analysis: Introduction- The Social network and How to Represent it-Types of Networks-Network parts and Level of Analysis-Networks as Social Structure and Institution- Theoretical Assumptions-Causality in Social Network Studies- A Brief History of Social Network Analysis-Mathematical Foundations: Graphs-Paths and components-Adjacency matrices-Ways and modes-Matrix products-Sources of network data-Types of nodes and types of ties- Data Collection: Network questions-Question formats-Interviewee burden-Data collection and reliability-Archival data collection-Data from electronic sources.

UNIT II MODELING AND VISUALIZATION **9**

Data Management: Data import-Cleaning network data- Data transformation-Normalization-Cognitive social structure data-Matching attributes and networks-Converting attributes tomatrices-Data export,- Multivariate Techniques Used in Network Analysis: Multidimensional scaling-Correspondence analysis-Hierarchical clustering,- Visualization: Layout-Embedding node attributes-Node filtering-Ego networks-Embedding tie characteristics-Visualizing network change-Exporting visualizations-Closing comments.

UNIT III DESCRIPTIVE AND INFERENTIAL METHODS **9**

Descriptive Methods in Social Network Analysis: Graph and Matrix-Social Network Representation – Density – Centrality, Centralization and Prestige- Cliques – Multidimensional Scaling(MDS) and Dendogram – Structural Equivalence-Two mode Networks and Bipartite

Matrix-Inferential Methods in Social Network Analysis: Permutation and QAP (Quadratic Assignment Procedure) Correlation-P* or Exponential Random Graph Model(ERGM)

UNIT IV EVOLUTION **9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT V APPLICATIONS **9**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Define the internal components and terminology of the social network.
CO2: Explain fundamental exploratory multivariate techniques and visualizing network data.
CO3: Discuss most common descriptive and inferential statistical tools available.
CO4: Discuss about the evolution of the social network.
CO5: Illustrate the real time applications of social network analysis.

TEXT BOOKS:

1. Song Yang , Franziska B. Keller, “Social Network Analysis Methods and Examples”, SAGE Publications Inc. 2017.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, “Analyzing Social Networks”, Second Edition, 2017.

REFERENCES:

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014 .
2. Przemyslaw Kazienko, Nitesh Chawla, “Applications of Social Media and Social Network Analysis”, Springer,2015.
3. Ajith Abraham, Aboul Ella Hassanien, Vaclav Snasel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012.
4. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011.
5. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012.

21CS936 PROFESSIONAL ETHICS IN ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To familiarize with Engineering Ethics and Human Values.
- To impart knowledge on codes of ethics, safety, responsibilities, and rights of engineers.
- To create awareness on global issues related to environmental ethics, computer ethics, weapons development and corporate social responsibility.

UNIT 1 HUMAN VALUES **9**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 8

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law - The Challenger Case Study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 10

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Case Studies: Chernobyl and Bhopal Disasters - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will be able to:

CO1: Summarize the importance of human values in workplace.
CO2: Discuss the senses of engineering ethics, moral dilemmas, moral autonomy and uses of ethical theories.
CO3: Describe the role of engineers as responsible experimenters and necessity of codes of ethics in engineering.
CO4: Explain safety, risk, responsibilities and rights in the society.
CO5: Analyze the global issues related to environmental ethics, computer ethics, weapons development and the role of engineers as expert witnesses and advisors.
CO6: Apply ethics in society and discuss the ethical issues related to engineering.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2014.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2013.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2012.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2018.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2012.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

21CS919 CYBER FORENSICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the basics of digital forensics
- To apply various forensics tools in evidence collections
- To illustrate analysis and validation methods in cyber forensics
- To summarize the mobile and cloud forensics
- To discuss about social media forensics and anti-forensics

UNIT I INTRODUCTION TO DIGITAL FORENSICS 9

An Overview of Digital Forensics – Preparing for Digital Investigations– Maintaining Professional Conduct – Computer Crime – Company Policy Violation – Understanding Data Recovery Workstations and Software–Data Acquisition: Storage Formats–Acquisition methods and Tools

UNIT II EVIDENCE COLLECTION AND FORENSICS TOOLS 9

Processing Crime and Incident Scenes - Identifying digital evidence – collecting evidence – preparing for a search - securing a digital incident – seizing and storing digital evidence – obtaining a digital hash -Current Digital Forensics Tools: Software and Hardware Tools.

UNIT III FORENSICS ANALYSIS AND VALIDATION 9

Data Collection and analysis - Validating Forensics Data – Data Hiding Techniques – Email and Social Media Investigations: Role of Email, client and server – Investigating email crimes –Digital forensics for social media.

UNIT IV MOBILE AND CLOUD FORENSICS 9

Introduction – Mobile Phone Technology – Forensic Challenges and process – Digital Cell Phone Investigations– Geographic Positioning Systems– Cameras – Common Extraction Types – Information Sources and Location information– Cloud Computing and Digital Forensics

UNIT V SOCIAL MEDIA FORENSICS AND ANTI-FORENSICS 9

Introduction to Social Media – Social Engineering Forensics – Anti-forensics definition and concepts–Anti-forensics methods – Eliminate Trails – Hide and Destroy evidence – Mobile anti-forensics

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the overview of digital forensics and data acquisition techniques.
CO2: Apply various forensics tools in processing digital crime scenes for evidences.
CO3: Illustrate analysis and validation methods in cyber forensic
CO4: Compare the mobile and cloud forensics
CO5: Describe social media forensics and anti-forensics

TEXT BOOK:

1. Bill Nelson, Amelia Phillips, Frank En finger, Christopher Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, Sixth Edition, 2018.

REFERENCES:

1. Greg Gogolin, "Digital Forensics Explained", CRC Press, Second Edition, 2021.
2. Roderick S. Graham, Shawn K. Smith, "Cybercrime and Digital Deviance", Taylor and Francis, First Edition, 2020.
3. Thomas J. Holt, Adam M. Bossler, Kathryn C. Seigfried – Spellar, "Cybercrime and Digital Forensics An Introduction", Routledge, Taylor and Francis", 2017.
4. Marjie T. Britz, "Computer Forensics and Cyber Crime: An Introduction", 3rd Edition, Pearson Education, 2013.
5. David Lilburn Watson, Andrew Jones, "Digital Forensics Processing and Procedures", Syngress, 2013.
6. Kenneth C.Brancik, "Insider Computer Fraud", Auerbach Publications, Taylor and Francis Group, 2008.

21CS921 QUANTUM COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To analyse the behaviour of basic quantum algorithms
- To discuss simple quantum algorithms and information channels in the quantum circuit model
- To apply the quantum algorithms in superdense coding and quantum teleportation
- To analyse the algorithms with super-polynomial speed-up

- To illustrate a simple quantum error-correcting code

UNIT I FOUNDATION 9

Overview of traditional computing – Church-Turing thesis – circuit model of computation – reversible computation – quantum physics – quantum physics and computation – Dirac notation and Hilbert Spaces – dual vectors – operators – the spectral theorem – functions of operators – tensor products – Schmidt decomposition theorem

UNIT II QUBITS AND QUANTUM MODEL OF COMPUTATION 9

State of a quantum system – time evolution of a closed system – composite systems – measurement – mixed states and general quantum operations – quantum circuit model – quantum gates – universal sets of quantum gates – unitary transformations – quantum circuits

UNIT III QUANTUM ALGORITHMS-I 9

Superdense coding – quantum teleportation – applications of teleportation – probabilistic versus quantum algorithms – phase kick-back – the Deutsch algorithm – the Deutsch- Jozsa algorithm – Simon's algorithm – Quantum phase estimation and quantum Fourier Transform – eigenvalue estimation

UNIT IV QUANTUM ALGORITHMS – II 9

Order-finding problem – eigenvalue estimation approach to order finding – Shor's algorithm for order finding – finding discrete logarithms – hidden subgroups – Grover's quantum search algorithm – amplitude amplification – quantum amplitude estimation– quantum counting – searching without knowing the success probability.

UNIT V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

Computational complexity – black-box model – lower bounds for searching – general black-box lower bounds – polynomial method – block sensitivity – adversary methods – classical error correction – classical three-bit code – fault tolerance – quantum error correction – three- and nine-qubit quantum codes – fault-tolerant quantum computation.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Analyse the behaviour of basic quantum algorithms

CO2: Discuss simple quantum algorithms and information channels in the quantum circuit model.

CO3: Apply the quantum algorithms in superdense coding and quantum Teleportation

CO4: Analyse the algorithms with super polynomial speed-up

CO5: Illustrate a simple quantum error-correcting code

TEXT BOOKS:

1. P. Kaye, R. Laflamme, and M. Mosca, “An introduction to Quantum Computing”, Oxford University Press, 2007.
2. E. Rieffel and W. Polak, “Quantum Computing A Gentle Introduction”, The MIT Press Cambridge, 2011.

REFERENCES:

1. Jack D. Hidary “Quantum Computing: An Applied Approach”, Springer, 2019.
2. V. Sahni, “Quantum Computing”, Tata McGraw-Hill Publishing Company, 2007.
3. Michael A. Nielsen and Issac L. Chuang, “Quantum Computation and Quantum Information”, Tenth Edition, Cambridge University Press, 2010

21CS923 RESOURCE MANAGEMENT TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To solve optimization problems.

- To solve problems in finding shortest route.
- To solve problems in linear programming and Integer programming.
- To solve problems in non-linear programming.
- Be exposed to CPM and PERT.

UNIT I LINEAR PROGRAMMING 9

Principal components of decision problem – Modeling phases – LP Formulation and graphic solution –Resource allocation problems – Simplex method – Sensitivity analysis.

UNIT II DUALITY AND NETWORKS 9

Definition of dual problem – Primal – Dual relationships – Dual simplex methods – Post optimality analysis – Transportation and assignment model – Shortest route problem.

UNIT III INTEGER PROGRAMMING 9

Cutting plan algorithm – Branch and bound methods, Multistage (Dynamic) programming.

UNIT IV CLASSICAL OPTIMISATION THEORY 9

Unconstrained external problems, Newton – Ralphson method – Equality constraints – Jacobean methods – Lagrangian method – Kuhn – Tucker conditions – Simple problems.

UNIT V OBJECT SCHEDULING 9

Network diagram representation – Critical path method – Time charts and resource leveling – PERT.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Use Simplex method to solve optimization problems
CO2: Solve the problems to find minimum cost and shortest route
CO3: Apply integer programming to solve real-life applications
CO4: Apply the methods to solve Non-linear programming problems
CO5: Use PERT andCPM for project management

TEXT BOOK:

1. H.A. Taha, "Operation Research", Prentice Hall of India, 2002.

REFERENCES:

1. Paneer Selvam, „Operations Research", Prentice Hall of India, 2002.
2. Anderson "Quantitative Methods for Business", 8th Edition, Thomson Learning, 2002.
3. Winston "Operation Research", Thomson Learning, 2003.
4. Vohra, "Quantitative Techniques in Management", Tata Mc Graw Hill, 2002.
5. Anand Sarma, "Operation Research", Himalaya Publishing House, 2003.

21CS927 UI/UX DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the principles of UI/UX Design in order to design with intention.
- To define the user experience and the psychology behind user decision making.
- To discuss about design principles involved in devolving good user interface.
- To apply technology for designing web applications with multimedia and effects.
- To describe meaningful user interface for mobile applications

UNIT I INTRODUCTION 9

Introduction about UX - Five Main Ingredients of UX - Three "Whats" of User Perspective - Pyramid of UX Impact - UX Is a Process - UX - Not an Event or Task. Behaviour Basics: Psychology versus Culture - User Psychology - Experience - Conscious vs Subconscious Experience - Emotions - Gain and Loss – Motivations.

UNIT II USER OBSERVATION AND EXPERIENCE 9

User Research - Subjective Research - Objective Research - Sample Size - Three Basic Types of Questions. Observe a User: Watch How They Choose - Interviews - Surveys - Card Sorting - Creating User Profiles - Bad profile - Useful profile.

UNIT III USER INTERFACE DESIGN PRINCIPLES 9

Designing Behaviour: Designing with Intention - Rewards and Punishments - Conditioning and Addiction - Timing Matters - Gamification - Social/Viral Structure–Trust - Hidden versus Visible. Basic Visual Design Principles: Visual Weight - Contrast - Depth and Size - Color. Layout: Page Framework - Footers - Navigation -Images, and Headlines - Forms - One Long Page or a Few Short Pages - Input Types - Labels and Instructions - Primary and Secondary Buttons - Adaptive and Responsive Design - Touch versus Mouse

UNIT IV WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Using Motion for UX - Design Pattern: Z-Pattern - F-Pattern - Visual Hierarchy - Lookup patterns – Feedback patterns.

UNIT V MOBILE INTERFACE DESIGN 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools-Explainable AI.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the principles of UI/UX Design in order to design with intention
CO2: Learn the effective user experience and the psychology behind user decision making.
CO3: Understand the importance of design principles for good user interface.
CO4: Elucidate the implications for designing web application with multimedia and effects.
CO5: Develop meaningful user interface for mobile applications.

TEXT BOOKS:

1. Joel Marsh, "UX for Beginners", O'Reilly Media, Inc., 1 st Edition 2015.
2. Xia Jiajia, "UI UX Design", O'Reilly, Artpower International, 2016.
3. Brian Fling, "Mobile Design and Development", O"Reilly Media Inc., 1st Edition, 2009.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004.
2. Alan Cooper, "The Essential Of User Interface Design", Wiley Dream Tech Ltd., 2002.\
3. https://www.uxai.design/#:~:text=for%20designers,for%20AI%20products%20and%20services.

21CS930 LEAN SIX SIGMA

L	T	P	C
3	0	0	3

OBJECTIVES:

- To gain insights about the importance of lean six sigma practices.
- To predict, prevent and control defects in a process.
- To understanding the methods of Lean six sigma
- To analyze the challenges through process improvement.
- To evaluate the manufacturing values.

UNIT I INTRODUCTION TO LEAN CONCEPTS 9

History- Statistical aspects - Six-sigma: Concepts, methodology-Objectives of lean manufacturing- key principles and implications of lean manufacturing traditional Vs lean manufacturing.

UNIT II LEAN MANUFACTURING CONCEPTS 9

Value creation and waste elimination-main kinds of waste-pull production-different models of pull production-continuous flow-continuous improvement / Kaizen-worker involvement - cellular layout-administrative lean.

UNIT III LEAN MANUFACTURING TOOLS AND METHODOLOGY 9

Standard work -communication of standard work to employees -standard work and flexibility -visual controls-quality at the source-5S principles -preventative maintenance total quality management-total productive maintenance -changeover/setup time -batch size reduction -production leveling-Value stream mapping-Procedure and principles.

UNIT IV SIX SIGMA CONCEPTS 9

History and development of Six Sigma – requirements of reliability – Definition – Common principles - failure rate – Fundamentals - FMEA - Roles and Responsibilities – Deliverables - challenges of six sigma - Defining a Six Sigma Project –Benefits and Application.

UNIT V APPLICATIONS OF SIX SIGMA CONCEPTS 9

Lean concept – Seven muda – 5S – JIT – Basic 6σ Concept – Standard Deviation - Pareto principle – voice of customer – 5why‟s – SIPOC Process - Building a 6σ team – DMAIC and DMADV – Case study.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: understand the concept of lean manufacturing.
CO2: understand the various tools and methods of lean manufacturing.
CO3: explain the various tools for lean manufacturing.
CO4: study the various concepts in six sigma.
CO5: describe the above tools to implement LM system in an organization.

TEXT BOOKS:

1. Askin R G and Goldberg J B, “Design and Analysis of Lean Production Systems”, John Wiley and Sons Inc., 2007.
2. Oakland J S, “TQM - Text with Cases”, Butterworth - Heinemann Ltd., Oxford, 3rd Edition, 2012.
3. Dale H Besterfiled, “Total Quality Management”, Pearson Education Asia, 3rd Edition, Indian Reprint 2012.

REFERENCES:

1. Janakiraman B and Gopal R K, “Total Quality Management -Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.
2. James R Evans and William M Lindsay, “The Management and Control of Quality”, 6 th Edition, South-Western (Thomson Learning), 2019.
3. Oakland J S, “TQM -Text with Cases”, Butterworth-Heinemann Ltd., Oxford, 3rd Edition, 2003.
4. Suganthi L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.

21IT927 INDIAN CONSTITUTION

L	T	P	C
3	0	0	3

OBJECTIVES:

The Course will enable learners to:

- To have some knowledge about Indian Constitution.
- To understand the concept of fundamental rights
- To learn about Lok Sabha and Rajya Sabha
- To have some knowledge about Legislative Assembly and Legislative Council
- To learn about Local Self Government

UNIT I INTRODUCTION 9

Meaning and Importance of Constitution, Preamble and Salient Features of the Constitution

UNIT II FUNDAMENTAL RIGHTS 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 and Duties, Directive Principles of State Policy.

UNIT III LOK SABHA AND RAJYA SABHA 9

Union Government – Lok Sabha and Rajya Sabha Composition, Powers, and functions: The President, The Prime Minister, and Supreme Court: Role Position and Powers/ functions.

UNIT IV LEGISLATIVE ASSEMBLY AND LEGISLATIVE COUNCIL 9

State Government - Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions

UNIT V LOCAL SELF GOVERNMENT 9

Local self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers, and function

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Interpret the knowledge on Indian Constitution.
CO2: Demonstrate the knowledge gained through fundamental rights concept.
CO3: Relate the concept of Lok Sabha and Rajya Sabha.
CO4: Illustrate the concept of Legislative Assembly and Legislative Council.
CO5: Analyze the concept of Local Self Government.

TEXT BOOK:

1. M V Pylee, An Introduction to The Constitution of India, Vikas Publishing House Pvt. Ltd., 5th Edition, 2007.

REFERENCES:

1. Durga Das Basu, Introduction to the Constitution of India, 19th Edition Reprint 2009.
2. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, 7th Edition, 2015.

21IT711	PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP	L	T	P	C
		0	0	6	3

OBJECTIVES:

- To empower students with overall Professional and Technical skills required to solve a real world problem.
- To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.
- To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.

HIGHLIGHTS OF THIS COURSE

This course is a four months immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.

To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. **This is an EEC category course offered as an elective, under the type, "Experiential Project Based Learning".**

Highlights of this course

- Students undergo training on emerging technologies
- Students develop solutions for real-world use cases
- Students work with mentors to learn and use industry best practices
- Students access and use Self-Learning courses on various technologies, approaches and methodologies.
- Collaborate in teams with other students working on the same topic
- Have a dedicated mentor to guide
-

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

TABLE 1: ACTIVITIES

Activity Name	Activity Description	Time(weeks)
Choosing a Project	Selecting a project from the list of projects categorized various technologies and business domains	2
Team Formation	Students shall form a team of 4 members before enrolling to a project. Team members shall distribute the project activities among themselves	1
Handson Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project	2
Project Development	Project shall be developed in agile mode. The status of the projects shall be update to the mentor via appropriate platform	6
Code Submission, Project Doc and Demo	Project Deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded cloud base repository such as GitHub	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestones schedule and the feedback will be provided to the team.	1

Evaluation and scoring	Evaluators will be assigned to the team to valuate the project deliverables, and the scoring will be provided based on the evaluation metrics	1	
TOTAL		**16 Weeks**	

OUTCOMES:

On completion of the course, the students will be able to:

- Upskill in emerging technologies and apply to real industry-level use cases
- Understand agile development process
- Develop career readiness competencies, Team Skills / Leadership qualities
- Develop Time management, Project management skills and Communication Skills
- Use Critical Thinking for Innovative Problem Solving
- Develop entrepreneurship skills to independently work on products

		L	T	P	C
21AM911	**DISTRIBUTED AND CLOUD COMPUTING (LAB INTEGRATED)**	**2**	**0**	**2**	**3**

OBJECTIVES:

- To understand the concepts and technologies of cloud computing.
- To have knowledge on the various types of cloud computing services.
- To describe the cloud infrastructure and virtualization.
- To describe high-level automation and orchestration systems that manage the virtualized infrastructure.
- To describe the programming paradigms used in cloud and how cloud software deployments scale to large numbers of users.

UNIT I INTRODUCTION 6+6

Principles of Distributed Computing: Elements of Distributed Computing – Technologies of Distributed Computing. Cloud Computing - Definition - Characteristics - Cloud Models - Cloud Services Examples - Cloud-based Services & Applications - Cloud Concepts & Technologies.

UNIT II CLOUD SERVICES AND PLATFORMS 6+6

Compute Services – Storage Services – Database Services – Application Services – Content Delivery Services – Analytics Services – Deployment and Management Services – Identity and Access Management Services – Open Source Private Cloud Software.

UNIT III CLOUD INFRASTRUCTURE AND VIRTUALIZATION 6+6

Data Center Infrastructure And Equipment – Virtual Machines – Containers – Virtual Networks - Virtual Storage: Persistent storage – NAS Technology- SAN Technology – Mapping virtual disks to physical disks - Object Storage.

UNIT IV AUTOMATION AND ORCHESTRATION 6+6

Automation - Orchestration: Automated Replication And Parallelism - The MapReduce Paradigm: The MapReduce Programming Paradigm – Splitting Input – Parallelism and Data size – Data access and Data Transmission – Apache Hadoop – Parts of Hadoop – HDFS Components – Block Replication and Fault Tolerance – HDFS and MapReduce.

UNIT V CLOUD PROGRAMMING PARADIGMS 6+6

Microservices - Serverless Computing And Event Processing – DevOps: Software Creation and Development – Software Development Cycle – The DevOps Approach – Continuous Integration – Continuous Delivery - Deployment.

Lab Exercises:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows 7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create *hello world* app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.

TOTAL: 30 + 30 = 60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Articulate the main concepts and key technologies of cloud computing.

CO2: Learn various cloud services and platforms to cater the requirements in the growth of the businesses.

CO3: Develop the ability to understand the cloud infrastructure and virtualization that help in the development of cloud.

CO4: Explain the high-level automation and orchestration systems that manage the virtualized infrastructure.

CO5: Summarizes the programming paradigms used in cloud and how cloud software deployments scale to large numbers of users.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-on Approach”, Universities Press Private Limited, 2014. (Unit 1, 2)
2. Douglass E. Comer, “The Cloud Computing Book: The future of computing explained”, CRC Press, 2021. (Unit 3, 4, 5)

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2017. (Unit 1)
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. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
4. George Reese, “Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

21CS918	GOOGLE CLOUD: ARCHITECTING WITH GOOGLE COMPUTE ENGINE	L	T	P	C
		2	0	2	3

OBJECTIVES:

- Learn about Google Cloud and how to interact with the Google Cloud Console and Cloud Shell.
- Create VPC networks and other networking objects.
- Understand virtual machines
- Create virtual machines using Compute Engine.

UNIT I GOOGLE CLOUD PLATFORM FUNDAMENTALS: CORE INFRASTRUCTURE **10**

Introducing Google Cloud Platform - The Google Cloud Platform resource hierarchy - Identity and Access Management (IAM) - Interacting with Google Cloud Platform - Cloud Marketplace – **Networking:** Virtual Private Cloud (VPC) Network - Compute Engine - Important VPC capabilities - **Storage:** Cloud Storage - Cloud Bigtable - Cloud SQL and Cloud Spanner - Cloud Datastore - Comparing Storage Options – **Containers** – Kubernetes - Kubernetes Engine – **AppEngine:** Introduction to App Engine - App Engine Standard Environment - App Engine Flexible Environment - Cloud Endpoints and Apigee Edge - Development in the Cloud - Deployment: Infrastructure as code – Monitoring: Proactive instrumentation - Google Cloud Big Data Platform - Google Cloud Machine Learning Platform.

UNIT II ESSENTIAL CLOUD INFRASTRUCTURE: FOUNDATION **9**

Introduction to GCP - Virtual Networking - Common Network Designs - Compute Engine - Working with Virtual Machines. Core Services: Introduction to core services - Cloud Identity and Access Management - Cloud Storage - Cloud SQL - Cloud Spanner and Datastore - Cloud Bigtable - Resource Management - Monitoring: Stack driver – Logging - Error Reporting - Tracing and Debugging.

UNIT III ESSENTIAL CLOUD INFRASTRUCTURE: CORE SERVICES **8**

Identity and Access management- Organization-Roles- Custom roles- Members- Service Accounts-Cloud IAM- Resource Manager-Quotas-Labels-Billing-Billing Administration

UNIT IV ELASTIC CLOUD INFRASTRUCTURE: SCALING AND AUTOMATION **9**

Introduction to Elastic Cloud Infrastructure - Cloud VPN - Cloud Interconnect and Peering - Sharing VPC Networks - Managed instance groups – Load balancing: HTTP(S) load balancing - SSL/TCP - Proxy load balancing - Network load balancing - Internal load balancing - Choosing a load balancer - Deployment Manager - GCP Marketplace - Managed Services.

UNIT V RELIABLE CLOUD INFRASTRUCTURE: DESIGN AND PROCESS **9**

Defining the service - Business-logic layer - Data layer design - Presentation layer - Design for Resiliency - Scalability and Disaster Recovery - Design for Security: Cloud security - Network access control and firewalls - Protections against Denial of Service - Resource sharing and Isolation - Data encryption and key management - Identity access and auditing - Capacity planning and cost optimization – Deployment - Monitoring and alerting - Incident response.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Recognize the purpose of various compute services such as Compute Engine, Kubernetes Engine, App Engine and Cloud Functions.

CO2: Explore the fundamental components of GCP's Virtual Private Cloud.

CO3: Manage and examine billing of Google Cloud resources

CO4: Explore various load balancing services and construct an HTTP load balancer with auto scaling.

CO5: Identity various steps involved in designing a solution using layered and iterative approach.

TEXT BOOK:

1. Sosinsky B., "Cloud computing bible", John Wiley and Sons, 2011.

REFERENCES:

1. Dinkar Sitaram, Geetha Manjunat, "Moving to the Cloud: Developing Apps in the New World of Cloud Computing", Elsevier, 2012.
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw Hill, 2010.

ONLINE MATERIALS

1. https://www.coursera.org/specializations/gcp-architecture
2. https://cloud.google.com/docs/

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE
(OFFERED TO OTHER B.E./B.Tech PROGRAMMES)

SI. No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	21AM925	Introduction to Data Science (Lab Integrated)	4	2	0	2	3
2.	21AM926	Artificial Intelligence	3	3	0	0	3
3.	21AM927	Data Exploration and Visualization	3	3	0	0	3
4.	21AM928	Machine Learning Algorithms	3	3	0	0	3
5.	21AM929	Foundations of Deep Learning	3	3	0	0	3
6.	21AM930	Natural Language Processing	3	3	0	0	3
7.	21AM931	Capstone Project	12	0	0	12	6

21AM925	INTRODUCTION TO DATA SCIENCE (LAB INTEGRATED)	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To explain the fundamentals of data science
- To experiment and implement python libraries for data science
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization tools in Python

UNIT I	INTRODUCTION	6+6

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II	PYTHON LIBRARIES FOR DATA SCIENCE	6+6

Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands - The Basics of NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and

Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance Pandas.

UNIT III	**CLASSIFICATION**	**6+6**

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

UNIT IV	**CLUSTERING AND OUTLIER DETECTION**	**6+6**

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

UNIT V	**DATA VISUALIZATION**	**6+6**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

LAB EXERCISES:

1. Download, install and explore the features of R/Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
    a) Frequency distributions
    b) Mean, Mode, Standard Deviation
    c) Variability
    d) Normal curves
    e) Correlation and scatter plots
    f) Correlation coefficient
    g) Regression
6. Use the standard benchmark data set for performing the following:
    a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
    b) Bivariate Analysis: Linear and logistic regression modelling.
    c) Multiple Regression Analysis
    d) Compare the results of the above analysis for the two data sets.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

Mini Projects

a) Recommendation system
b) Credit Card Fraud Detection
c) Fake News Detection
d) Customer Segmentation
e) Sentiment Analysis
f) Recommender Systems
g) Emotion Recognition
h) Stock Market Prediction
i) Email classification

j) Tweets classification
k) Uber Data Analysis
l) Social Network Analysis

TOTAL: 30+30=60 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the fundamentals of data science
CO2: Experiment python libraries for data science
CO3: Apply and implement basic classification algorithms
CO4: Implement clustering and outlier detection approaches
CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017

REFERENCES:

1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017
4. Avrim Blum, John Hopcroft, Ravi Kannan, "Foundations of Data Science", 1st Edition, Cambridge University Press, 2020.

21AM926	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the foundations of AI and various intelligent agents
- To discuss problem solving search strategies and game playing
- To describe logical agents and first-order logic
- To illustrate problem-solving strategies with knowledge representation mechanism for solving hard problems
- To explain the basics of learning and expert systems.

UNIT I	ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS	9

Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies

UNIT II	PROBLEM SOLVING	9

Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP

UNIT III	LOGICAL AGENTS	9

Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic

First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining - Resolution

UNIT IV	**KNOWLEDGE REPRESENTATION AND PLANNING**	**9**

Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information

Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – Non-deterministic domains – Time, schedule, and resources - Analysis

UNIT V	**LEARNING AND EXPERT SYSTEMS**	**9**

Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.

Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the foundations of AI and various Intelligent agents

CO2: Apply search strategies in problem solving and game playing

CO3: Explain logical agents and first-order logic

CO4: Apply problem-solving strategies with knowledge representation mechanism for solving hard problems

CO5: Describe the basics of learning and expert systems.

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
2. Bratko, Prolog: Programming for Artificial Intelligence‖, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems,1st Edition by Patterson, Pearson, India, 2015

21AM927	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To outline an overview of exploratory data analysis and phases involved in data analytics
- To acquire an in-depth knowledge in EDA techniques
- To experiment the data visualization
- To describe the methods of time series analysis
- To explain the basics of tree and hierarchical representation of big data

UNIT I	EXPLORATORY DATA ANALYSIS	9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA

UNIT II	EDA TECHNIQUES	9

Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques -Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.

UNIT III	VISUALIZING DATA	9

The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping-Location, Data, two sided data ranges, smooth interpolation of values over time

UNIT IV	TIME SERIES ANALYSIS	9

Overview of time series analysis-showing data as an area, drawing tabs, handling mouse input, Connections And Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues

UNIT V	TREES, HIERARCHIES, AND RECURSION	9

Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the overview of exploratory data analysis and phases involved in data analytics
CO2: Explore in-depth knowledge in EDA techniques
CO3: Apply the visualization techniques in data
CO4: Describe the methods of time series analysis
CO5: Represent the data in tree and hierarchical formats

TEXT BOOKS:

1. Suresh Kumar Mukhiya and Usman Ahmed, "Hands-on Exploratory Data Analysis with Python", Packt publishing , March 2020.
2. Ben Fry, "Visualizing Data", O'reilly publications, 2007.

REFERENCES:

1. Danyel Fisher & Miriah Meyer, "Making Data Visual: A Practical Guide To Using Visualization For Insight", O'reilly publications, 2018.
2. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3. EMC Education Services, "Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley Publishers, 2015.
4. Tamara Munzner, "Visualization Analysis and Design", A K Peters/CRC Press; 1st edition, 2014.
5. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

21AM928	MACHINE LEARNING ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To discuss the basics of Machine Learning and Supervised Algorithms.
- To understand the various classification algorithms.
- To study dimensionality reduction techniques.
- To elaborate on unsupervised learning techniques.
- To discuss various Graphical models and understand the basics of reinforcement learning.

UNIT I	INTRODUCTION	9

Machine Learning – Types – Applications – Preparing to Model – Activities – Data – Exploring structure of Data – Data Quality and Remediation – Data Pre-processing – Modelling and Evaluation: Selecting a Model -Training a Model – Model representation and Interpretability – Evaluating Performance of a Model – Improving Performance.

UNIT II	FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION	9

Feature Engineering – Feature Transformation – Feature Subset Selection - Principle Component Analysis – Feature Embedding – Factor Analysis – Singular value decomposition and Matrix Factorization – Multidimensional scaling – Linear Discriminant Analysis – Canonical Correlation Analysis – Isomap – Locally linear Embedding – Laplacian Eigenmaps.

UNIT III	SUPERVISED LEARNING	9

Linear Regression -Relation between two variables – Steps – Evaluation – Logistic Regression – Decision Tree – Algorithms – Construction – Classification using Decision Tree – Issues – Rule-based Classification – Pruning the Rule Set – Support Vector Machines – Linear SVM – Optimal Hyperplane – Radial Basis Functions – Naïve Bayes Classifier – Bayesian Belief Networks.

UNIT IV	UNSUPERVISED LEARNING	9

Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.

UNIT V	NEURAL NETWORKS AND TYPES OF LEARNING	9

Biological Neuron – Artificial Neuron – Types of Activation function – Implementations of ANN – Architectures of Neural Networks – Learning Process in ANN – Back propagation – Deep Learning – Representation Learning – Active Learning – Instance based Learning – Association Rule Learning

– Ensemble Learning Algorithm – Regularization Algorithm- Reinforcement Learning – Elements- Model-based- Temporal Difference Learning.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the basics of Machine Learning and Supervised Algorithms.
CO2: Understand the various classification algorithms.
CO3: Study dimensionality reduction techniques.
CO4: Elaborate on unsupervised learning techniques.
CO5: Understand various Graphical models and understand the basics of reinforcement learning.

TEXT BOOKS:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, "Machine Learning", Pearson, 2019. (Unit 1 – chap 1,2,3/ Unit 2 – Chap 4 / Unit 4 – 9 / Unit 5 – Chap 10, 11)
2. Ethem Alpaydin, "Introduction to Machine Learning, Adaptive Computation and Machine Learning Series", Third Edition, MIT Press, 2014. (Unit 2 – Chap 6 / Unit 4 – chap 8.2.3 / Unit 5 – Chap 18)

REFERENCES:

1. Anuradha Srinivasaraghavan,Vincy Joseph, "Machine Learning", First Edition, Wiley, 2019. (Unit 3 – Chap 7,8,9,10,11 / Unit 4 – 13, 11.4, 11.5,12)
2. Peter Harrington, "Machine Learning in Action", Manning Publications, 2012.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
4. Tom M Mitchell, "Machine Learning", First Edition, McGraw Hill Education, 2013.
5. Christoph Molnar, "Interpretable Machine Learning - A Guide for Making Black Box Models Explainable", Creative Commons License, 2020.

21AM929	FOUNDATIONS OF DEEP LEARNING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basics of deep neural networks.
- To discuss advanced deep learning models.
- To understand CNN and RNN architectures of deep neural networks.
- To familiarize autoencoders in neural networks.
- To learn about the deep generative models.

UNIT I	DEEP NETWORKS	9

Challenges motivating deep learning - Deep feedforward networks - Learning XOR - Gradient based learning - Hidden Units – Architecture Design – Back Propagation – Regularization – Parameter Norm Penalties – Constrained Optimization – Under-Constrained Problems – Dataset Augmentation – Noise Robustness – Semi-Supervised Learning – Multi-Task Learning – Early Stopping – Parameter Tying and Sharing – Bagging and Other Ensemble methods – Dropout – Adversarial Training.

UNIT II	OPTIMIZATION FOR TRAINING DEEP MODELS	9

Pure optimization – Challenges – Basic Algorithms – Parameter initialization Strategies – Algorithms with Adaptive Learning Rates – Approximate Second-Order methods – Optimization Strategies and Meta Algorithms.

UNIT III	CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS	9

Convolution Operation – motivation – Pooling – Infinitely Strong prior – Variants – Structured Output – Data Types – Efficient Convolutional Algorithms – Random or Unsupervised features –

Neuroscientific Basis - Deep Learning – Sequence Modelling - Computational Graphs - RNN - Bidirectional RNN – Encoder-Decoder - Sequence to Sequence RNN - Deep Recurrent Networks - Recursive Neural Networks -- Long Term Dependencies; Leaky Units – Strategies for multiple time scales – LSTM and Gated RNNs – Optimization for Long Term Dependencies.

UNIT IV	AUTOENCODERS	9

Autoencoders: Undercomplete autoencoders - Regularized autoencoders – Power, Layer Size and Depth - Stochastic encoders and decoders – Denoising Autoencoders - Learning with autoencoders – contractive Autoencoders – Applications of autoencoders.

UNIT V	DEEP GENERATIVE MODELS	9

Boltzmann Machine – Restricted Boltzmann Machine – Deep Belief Networks – Deep Boltzmann Machines - Boltzmann Machines for Real-Valued Data – Convolutional Boltzmann Machines - Boltzmann Machine for Structured or Sequential Outputs – Directed Generative Nets – Evaluating Generative Models.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the basics of deep neural networks**.**
CO2: Describe advanced deep learning models.
CO3: Understand and Implement CNN and RNN architectures of deep neural networks.
CO4: Learn autoencoders in neural networks.
CO5: Apply deep generative models to solve real world problems.

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.

REFERENCES:

1. Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook'', Springer International Publishing, 2018.
2. Yoav Goldberg, ``Neural Network Methods for Natural Language Processing'', Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.
3. Francois Chollet, ``Deep Learning with Python'', Manning Publications Co, 2018.
4. Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach'', O'Reilly Media, 2017.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

21AM930	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of natural language processing
- To perform word level analysis.
- To understand the significance of Syntactic analysis.
- To understand the role of semantics and pragmatics.
- To learn discourse algorithms and various lexical resources.

UNIT I	INTRODUCTION	6

Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT II	WORD LEVEL ANALYSIS	6

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III	SYNTACTIC ANALYSIS	6

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT IV	SEMANTICS AND PRAGMATICS	6

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V	DISCOURSE ANALYSIS AND LEXICAL RESOURCES	6

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

TOTAL: 45 PERIODS

LAB EXERCISES:

1. Implement a Recurrent Neural Networks (RNN) and process any sequential data such as characters, words or video frames.
2. Implement Speech processing using RNN with Long Short Term Networks (LTSM).
3. Implement text classifier using RNN.
4. Implement image classifier using CNN.
5. Develop a code to design object detection and classification for traffic analysis using CNN.
6. Implement image augmentation using deep RBM.
7. Surveillance Video Analytics for Compliance & Quality Monitoring (Mini Project)

OUTCOMES:

At the end of this course, the students will be able to:

- Apply the fundamentals of natural language processing.
- Perform word level analysis.
- Analyze the syntax using various methods.
- Understand the role of semantics and pragmatics.
- Use discourse algorithms and various lexical resources.

TEXT BOOKS:

1. Daniel Jurafsky, James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2019.

REFERENCES:

1. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", First Edition, O'Reilly Media, 2009.
2. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
3. Richard M Reese, "Natural Language Processing with Java", O'Reilly Media, 2015.
4. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
5. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

OPEN ELECTIVE COURSES (OE) OFFERED TO OTHER DEPARTMENTS

S. No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	21AM001	Artificial Intelligence and Machine Learning	3	3	0	0	3
2.	21AM002	Data Science	3	3	0	0	3
3.	21AM003	Data Exploration, Feature Engineering andVisualization	3	3	0	0	3
4.	21AM402	Data Analytics	3	3	0	0	3

21AM001 **ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the basics of Artificial Intelligence and Machine Learning.
- To explain the various algorithms in Heuristic Search and Game Playing.
- To discuss knowledge representation and reasoning.
- To apply the various Machine Learning algorithms.
- To apply Supervised and unsupervised learning algorithms.

UNIT I INTRODUCTION 9

Artificial Intelligence – Learning Systems – Knowledge Representation and Reasoning – Planning – Knowledge Acquisition – Intelligent Search – Logic Programming – Soft Computing – Management of Imprecision and Uncertainty – Production systems – State Space Representation – Branches of AI – Applications of AI.

UNIT II HEURISTIC SEARCH AND GAME PLAYING 9

Generate and Test – Hill Climbing – Search Techniques – Problem Reduction – Constraints Satisfaction - Means-end Analysis – Game Playing: MINMAX Procedure – Alpha-Beta Pruning – Combined Approach.

UNIT III KNOWLEDGE REPRESENTATION AND REASONING 9

Knowledge Management – Types of Knowledge - Knowledge Representation – Approaches – Issues – Knowledge base – First-order Logic – Frames – Types of Reasoning – Inference Methods.

UNIT IV MACHINE LEARNING ALGORITHMS 9

Types of Learning – Machine Learning – Intelligent Agents – Association Learning – Basics – Apriori Algorithm – Clustering – k-means Clustering – Fuzzy Clustering – Reinforcement Learning – Markov Decision Problem – Q-Learning – Statistical Learning – Hidden Markov

Model – Linear Classifiers – Quadratic Classifiers – Decision Trees – Bayesian Networks – ANN Basics.

UNIT V SUPERVISED AND UNSUPERVISED LEARNING 9

Supervised Learning: Support Vector Machines – Inductive Logic Programming – Ensemble Classifiers – Nearest Neighbourhood – Fuzzy Network – Unsupervised Learning: Expectation Maximization – Self-Organizing Maps – Adaptive Resonance Theory – Characteristics of Expert Systems.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Understand the basics of Artificial Intelligence and Machine Learning.
CO2: Explain the various algorithms in Heuristic Search and Game Playing.
CO3: Discuss knowledge representation and reasoning.
CO4: Apply the various Machine Learning algorithms.
CO5: Apply Supervised and unsupervised learning algorithms

TEXT BOOKS:

1. Vinod Chandra S S, Anand Hareendran S, "Artificial Intelligence and Machine Learning", PHI Learning Private Limited, 2014.

REFERENCES:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.

21AM002 DATA SCIENCE

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the fundamentals of data science
- To experiment and implement python libraries for data science
- To apply and implement basic classification algorithms
- To apply clustering and outlier detection approaches.
- To present and interpret data using visualization tools in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II PYTHON LIBRARIES FOR DATA SCIENCE 9

Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands - The Basics of NumPy Arrays-Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance Pandas.

UNIT III CLASSIFICATION 9

Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.

Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.

UNIT IV CLUSTERING AND OUTLIER DETECTION 9

Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches.

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the fundamentals of data science
CO2: Experiment python libraries for data science
CO3: Apply and implement basic classification algorithms
CO4: Implement clustering and outlier detection approaches
CO5: Present and interpret data using visualization tools in Python

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012
3. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", Kindle Edition, 2017

REFERENCES:

1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016
2. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017
4. Avrim Blum, John Hopcroft, Ravi Kannan, "Foundations of Data Science", 1st Edition, Cambridge University Press, 2020.

		L	T	P	C
21AM003	**DATA EXPLORATION, FEATURE ENGINEERING AND VISUALIZATION**	3	0	0	3

UNIT I EXPLORATORY DATA ANALYSIS 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA.

Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques -Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.

UNIT II FEATURE ENGINEERING 9

Text Data – Visual Data – Feature-based Time-Series Analysis – Data Streams – Feature Selection and Evaluation.

UNIT III VISUALIZING DATA 9

The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping-Location, Data, two sided data ranges, smooth interpolation ofvalues over time.

UNIT IV TIME SERIES ANALYSIS 9

Overview of time series analysis-showing data as an area, drawing tabs, handling mouse input, Connections And Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues.

UNIT V TREES, HIERARCHIES, AND RECURSION 9

Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data.

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Explain the overview of exploratory data analysis and phases involved in data analyticsCO2: Explore in-depth knowledge in EDA techniques
CO3: Apply the visualization techniques in data CO4:
Describe the methods of time series analysis
CO5: Represent the data in tree and hierarchical formats

TEXTBOOKS:

1. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, PacktPublishing , First Edition,March 2020.
2. Guozhu Dong, Huan Liu, "Feature Engineering for Machine Learning and Data Analytics", First Publication, CRC Press, First edition, 2018.
3. Ben Fry, “Visualizing Data”, O’reilly Publications, First Edition, 2007.

REFERENCES:

1. Danyel Fisher andMiriah Meyer, “Making Data Visual: A Practical Guide To UsingVisualization For Insight”, O’reilly publications, 2018.
2. Claus O. Wilke, ”Fundamentals of Data Visualization”, O’reilly publications, 2019.
3. EMC Education Services, “Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.
4. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition, 2014.
5. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.

21AM402 DATA ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the fundamentals of big data and data analytics
- To discuss the Hadoop framework
- To explain about exploratory data analysis and data manipulation tools
- To analyse and interpret streaming data
- To discuss various applications of data analytics

UNIT I INTRODUCTION 9

Evolution of Big Data- Definition of Big Data-Challenges with Big Data- Traditional Business Intelligence (BI) versus Big Data- Introduction to big data analytics- Classification of Analytics-Analytics Tools- Importance of big data analytics.

UNIT II HADOOP FRAMEWORK 9

Introducing Hadoop- RDBMS versus Hadoop-Hadoop Overview-HDFS (Hadoop Distributed File System)- Processing Data with Hadoop- Managing Resources and Applications with Hadoop

YARN - Interacting with Hadoop Ecosystem.

UNIT III EXPLORATORY DATA ANALYSIS 9

EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA –Data transformation techniques - Introduction to NoSQL – MongoDB: RDBMS Vs MongoDB – Data Types – Query Language – Hive – Hive Architecture – Data Types – File Formats - Hive Query Language (HQL) – RC File Implementation – User Defined Functions.

UNIT IV MINING DATA STREAMS 9

The data stream model – stream queries-sampling data in a stream-general streaming problem-filtering streams-analysis of filtering- dealing with infinite streams- Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT V APPLICATIONS 9

Application: Sales and Marketing – Industry Specific Data Mining – microRNA Data Analysis Case Study – Credit Scoring Case Study – Data Mining Nontabular Data.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

CO1: Explain the fundamentals of big data and data analytics
CO2: Discuss the Hadoop framework
CO3: Explain about exploratory data analysis and data manipulation tools
CO4: Analyse and interpret streaming data
CO5: Illustrate various applications of data analytics

TEXT BOOKS:

1. Subhashini Chellappan, Seema Acharya, “Big Data and Analytics”, 2nd edition, Wiley Publications, 2019.
2. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt publishing, March 2020.
3. Jure Leskovek, Anand Rajaraman and Jefrey Ullman,” Mining of Massive Datasets. v2.1”, Cambridge University Press,2019.
4. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II : A Practical Guide To Data Visualization, Advanced Data Mining Methods, and Applications, Wiley 2009.

REFERENCES:

1. Nelli, F., Python Data Analytics: with Pandas, NumPy and Matplotlib, Apress, 2018.
2. Bart Baesens," Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", John Wiley and Sons, 2014
3. Min Chen, Shiwen Mao, Yin Zhang, Victor CM Leung, Big Data: Related Technologies, Challenges and Future Prospects, Springer, 2014.
4. Michael Minelli, Michele Chambers, Ambiga Dhiraj, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends”, John Wiley and Sons, 2013.
5. Marcello Trovati, Richard Hill, Ashiq Anjum, Shao Ying Zhu, “Big Data Analytics and cloud computing – Theory, Algorithms and Applications”, Springer International Publishing, 2016.