ARUNAI
Engineering College
(An Autonomous Institution)
Tiruvannamalai

Approved by AICTE, Affiliated to Anna University, 'A' Grade
Accredited by NAAC, NBA Accredited, ISO 9001: 2015 Certified)

CURRICULUM AND SYLLABUS
B.TECH-ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
(Regulation 2024)

HoD/BOS Chairman **Principal**

ARUNAI ENGINEERING COLLEGE, TIRUVANNAMALAI

(An Autonomous Institution)

REGULATION 2024

CHOICE BASED CREDIT SYSTEM
B. Tech -ARTIFICIAL INTELLEGENCE AND DATA SCIENCE

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

PEO1: Utilize their proficiencies in the fundamental knowledge of basic sciences, mathematics, Artificial Intelligence, data science and statistics to build systems that require management and analysis of large volumes of data.

PEO2: Advance their technical skills to pursue pioneering research in the field of AI and Data Science and create disruptive and sustainable solutions for the welfare of ecosystems.

PEO3: Think logically, pursue lifelong learning and collaborate with an ethical attitude in a multidisciplinary team.

PEO4: Design and model AI based solutions to critical problem domains in the realworld.

PEO5: Exhibit innovative thoughts and creative ideas for effective contribution towards economy building.

PROGRAM OUTCOMES (POS)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values,

diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

WASHINGTON ACCORD KNOWLEDGE AND ATTITUDE PROFILE (WKS)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behaviour and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates should be able to:

PSO1: Evolve AI based efficient domain specific processes for effective decision making in several domains such as business and governance domains.

PSO2: Arrive at actionable Foresight, Insight, hindsight from data for solving business and engineering problems

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

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ARUNAI ENGINEERING COLLEGE

(AUTONOMOUS)
TIRUVANNAMALAI
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CHOICE BASED CREDIT SYSTEM

B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM AND SYLLABI FOR I TO VIII SEMESTERS
SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	IP24101	Induction Programme		-	-	-		0
THEORY								
2	HS24101	Professional English-I	HSMC	3	0	0	3	3
3	MA24101	Matrices and Calculus	BSC	3	1	0	4	4
4	PH24101	Engineering Physics	BSC	3	0	0	3	3
5	CY24101	Engineering Chemistry	BSC	3	0	0	3	3
6	GE24101	Problem Solving and Python Programming	ESC	3	0	0	3	3
7	GE24102	Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8	GE24111	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9	BS24111	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10	GE24112	English Laboratory($)	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course

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SEMESTER II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	HS24201	Professional English – II	HSMC	2	0	0	2	2
2	MA24201	Statistics and Numerical Methods	BSC	3	1	0	4	4
3	PH24203	Physics for Information Science	BSC	3	0	0	3	3
4	BE24201	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
5	GE24201	Engineering Graphics	ESC	2	0	4	4	4
6	AD24201	Data Structures Design	PCC	3	0	0	3	3
7	GE24202	Tamils and Technology	HSMC	1	0	0	1	1
8		NCC Credit Course Level 1[#]		2	0	0	2	2[#]
PRACTICALS								
9	GE24211	Engineering Practices Laboratory	ESC	0	0	4	4	2
10	AD24211	Data Structures Design Laboratory	PCC	0	0	4	4	2
11	GE24212	Communication Laboratory / Foreign Language[($)]	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**16**	**34**	**26**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

$ Skill Based Course

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SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA24301	Discrete Mathematics	BSC	3	1	0	4	4
2.	CS24305	Digital Principles and Computer Organization	ESC	3	0	0	3	3
3.	CS24303	Computer Networks	PCC	3	0	0	3	3
4.	AD24301	Artificial Intelligence	PCC	3	0	0	3	3
5.	AD24302	Data Visualization	PCC	2	0	2	4	3
6	AD24303	Algorithm Design Techniques	PCC	3	0	0	3	3
PRACTICALS								
7.	CS24313	Networks Laboratory	PCC	0	0	3	3	1.5
8.	AD24311	Artificial Intelligence Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**17**	**1**	**8**	**26**	**22**

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SEMESTER IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA24401	Probability and Statistics	BSC	3	1	0	4	4
2	AD24401	Fundamentals of Data Science and Analytics	PCC	3	0	0	3	3
3.	AD24402	Fundamentals of Operating Systems	PCC	3	0	0	3	3
4	AD24403	Database Design and Management	PCC	3	0	0	3	3
5	AM24404	Machine Learning	PCC	2	0	2	4	3
6.	GE24901	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
PRACTICALS								
7.	AD24413	Database Design and Management Laboratory	PCC	0	0	3	3	1.5
8.	CS24413	Data Science Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**16**	**1**	**8**	**25**	**21**

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SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AD24501	Deep Learning	PCC	3	0	0	3	3
2.	AD24502	Data Analytics	PCC	3	0	0	3	3
3.	CS24503	Embedded Systems and IoT	ESC	3	0	0	3	3
4.		Open Elective-1	OEC	3	0	0	3	3
5.		Professional Elective-I	PEC	2	0	2	4	3
6		Professional Elective-II	PEC	2	0	2	4	3
PRACTICALS								
7.	AD24511	Deep Learning Laboratory	PCC	0	0	4	4	2
8.	AD24512	Data Analytics Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**16**	**0**	**11**	**27**	**21.5**

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SEMESTER VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	AM24601	Natural Language Processing	PCC	3	0	0	3	3
2.	AD24601	Distributed Computing	PCC	3	0	0	3	3
3.		Open Elective – II	OEC	3	0	0	3	3
4.		Open Elective – III	OEC	3	0	0	3	3
5.		Professional Elective-III	PEC	2	0	2	4	3
6.		Professional Elective-IV	PEC	2	0	2	4	3
7.		Mandatory Course-I	MC	3	0	0	3	Non-credit course
PRACTICALS								
8.	AD24611	Intelligence Systems Laboratory	PCC	0	0	3	3	1.5
9.	AD24612	Mini Project	EEC	0	0	4	4	2
			TOTAL	**19**	**0**	**11**	**30**	**21.5**

Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-I)

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SEMESTER VII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GE24902	Human Values and Ethics	HSMC	2	0	0	2	2
2.	CB24701	Data and Information Security	PCC	3	0	0	3	3
3.		Elective - Management	HSMC	3	0	0	3	3
4.		Professional Elective-V	PEC	2	0	2	4	3
5.		Professional Elective-VI	PEC	2	0	2	4	3
6.		Mandatory Course-II	MC	3	0	0	3	Non-Credit Course
PRACTICALS								
7.	CB24711	Data Security Lab	PCC	0	0	3	3	1.5
8.	AD24711	Summer Internship	EEC	0	0	0	0	2
9.	AD24712	Computational Learning Lab	PCC	0	0	3	3	1.5
		TOTAL		**15**	**0**	**10**	**25**	**19**

Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-I)

SEMESTER VIII

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	AD24811	Project Work	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

TOTAL CREDITS: 163

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Name of the Programme: B.Tech Artificial Intelligence and Data Science										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4	3					5		12
2	BSC	12	7		6					25
3	ESC	5	9	4		3	7.5			28.5
4	PCC		5	3	15	9.5	6	6		44.5
5	PEC			15		6	6	6		33
6	OEC					3	2			5
7	EEC	1	2					2	10	15
8	Non-Credit /(Mandatory)					√	√			
Total		22	26	22	21	21.5	21.5	19	10	163

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Vertical I AIDS	Vertical II Full Stack Development	Vertical III Cloud Computing and Data Center Technologies	Vertical IV Cyber Security and Data Privacy	Vertical V Creative Media	Vertical VI Emerging Technologies
Knowledge Engineering	App Development	Cloud Computing	Ethical Hacking	Multimedia and Animation	Augumented Reality/Virtual Reality
Soft Computing	Internet Programming	Virtualization	Digital and Mobile Forensics	Video Creation and Editing	Robotic Process Automation
Text and Speech Analysis	UI and UX Design	Cloud services Management	Social Network Security	Game Theory	Neural Networks and Deep Learning
Ethics & AI	Software Testing and Automation	Data Warehousing	Modern Cryptography	Digital Marketing	Cyber Security
Image and video analytics	Web Application Security	Storage Technologies	Malware Analysis	Multimedia Data Compression and Storage	Cryptocurrency and Blockchain Technologies
Computer Vision	Devops	Software Defined Networks	Quantum Computing	Game Development	Cognitive Science
Exploratory Data Analysis	Principles of Programming Languages	Security and Privacy in Cloud	Network Security	Visual Effects	3D Printing and Design

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S.NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PROFESSIONAL ELECTIVE COURSES: VERTICAL – I								
1.	CCS2405	Knowledge Engineering	PEC	2	0	2	4	3
2.	CCS2406	Soft Computing	PEC	2	0	2	4	3
3.	CCS2407	Text and Speech Analysis	PEC	2	0	2	4	3
4.	CCS2402	Ethics & AI	PEC	2	0	2	4	3
5.	CCS2436	Image and video analytics	PEC	2	0	2	4	3
6.	CCS2437	Computer Vision	PEC	2	0	2	4	3
7.	CCS2435	Exploratory Data Analysis	PEC	2	0	2	4	3
PROFESSIONAL ELECTIVE COURSES: VERTICAL – II								
8.	CCS2408	App Development	PEC	2	0	2	4	3
9.	CS24404	Internet Programming	PEC	2	0	2	4	3
10.	CCS2410	UI and UX Design	PEC	2	0	2	4	3
11.	CCS2411	Software Testing and Automation	PEC	2	0	2	4	3
12.	CCS2404	Web Application Security	PEC	2	0	2	4	3
13.	CCS2412	Devops	PEC	2	0	2	4	3
14.	CCS2413	Principles of Programming Languages	PEC	2	0	2	4	3
PROFESSIONAL ELECTIVE COURSES: VERTICAL – III								
15.	CCS2403	Cloud Computing	PEC	2	0	2	4	3
16.	CCS2414	Virtualization	PEC	2	0	2	4	3
17.	CCS2409	Cloud services Management	PEC	2	0	2	4	3
18.	CCS2415	Data Warehousing	PEC	2	0	2	4	3
19.	CCS2416	Storage Technologies	PEC	2	0	2	4	3
20.	CCS2417	Software Defined Networks	PEC	2	0	2	4	3
21.	CCS2418	Security and Privacy in Cloud	PEC	2	0	2	4	3
PROFESSIONAL ELECTIVE COURSES: VERTICAL – IV								
22.	CCS2419	Ethical Hacking	PEC	2	0	2	4	3
23.	CCS2420	Digital and Mobile Forensics	PEC	2	0	2	4	3
24.	CCS2421	Social Network Security	PEC	2	0	2	4	3
25.	CCS2422	Modern Cryptography	PEC	2	0	2	4	3
26.	CCS2440	Malware Analysis	PEC	2	0	2	4	3
27.	CCS2433	Quantum Computing	PEC	2	0	2	4	3
28.	CCS2446	Network Security	PEC	2	0	2	4	3
PROFESSIONAL ELECTIVE COURSES: VERTICAL – V								

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29.	CCS2425	Multimedia and Animation	PEC	2	0	2	4	3
30.	CCS2426	Video Creation and Editing	PEC	2	0	2	4	3
31.	CCS2439	Game Theory	PEC	2	0	2	4	3
32.	CCS2427	Digital Marketing	PEC	2	0	2	4	3
33.	CCS2428	Multimedia Data Compression and Storage	PEC	2	0	2	4	3
34.	CCS2429	Game Development	PEC	2	0	2	4	3
35.	CCS2430	Visual Effects	PEC	2	0	2	4	3
PROFESSIONAL ELECTIVE COURSES: VERTICAL – VI								
36.	CCS2424	Augmented Reality/Virtual Reality	PEC	2	0	2	4	3
37.	CCS2431	Robotic Process Automation	PEC	2	0	2	4	3
38.	CCS2401	Neural Networks and Deep Learning	PEC	2	0	2	4	3
39.	CCS2432	Cyber Security	PEC	2	0	2	4	3
40.	CCS2423	Cryptocurrency and Blockchain Technologies	PEC	2	0	2	4	3
41.	CCS2438	Cognitive Science	PEC	2	0	2	4	3
42.	CCS2434	3D Printing and Design	PEC	2	0	2	4	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES–I (EMERGING TECHNOLOGIES)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OBA2401	Digital Marketing	OEC	3	0	0	3	3
2.	OEC2405	Drone Technologies	OEC	3	0	0	3	3
3.	OCE2401	Environmental and Social Impact Assessment	OEC	3	0	0	3	3
4.	OEE2405	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
5.	OHS2403	Graph Theory	OEC	3	0	0	3	3
6.	OAG2403	IoT in Agricultural System	OEC	3	0	0	3	3

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OPEN ELECTIVES –II (INDUSTRIAL)

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OME2401	Applied design thinking	OEC	3	0	0	3	3
2.	OME2402	Introduction to industrial automation systems	OEC	3	0	0	3	3
3.	OME2403	Industrial Management	OEC	3	0	0	3	3
4.	OME2404	Quality Engineering	OEC	3	0	0	3	3
5.	OME2405	Sustainable Manufacturing	OEC	3	0	0	3	3
6.	OME2406	Industrial design and rapid prototyping techniques	OEC	3	0	0	3	3
7.	OEE2401	Industrial IOT and industry 4.0	OEC	3	0	0	3	3
8.	OEC2402	Robotics and industrial Automation	OEC	3	0	0	3	3

OPEN ELECTIVES–III & IV

SL. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OAG2401	Urban agriculture	OEC	3	0	0	3	3
2.	OAG2402	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
3.	OBT2401	Basics of Biomolecules	OEC	3	0	0	3	3
4.	OBT2402	Basics of Microbial Technology	OEC	3	0	0	3	3
5.	OBT2403	Biotechnology for Waste Management	OEC	3	0	0	3	3
6.	OBT2404	Food Processing Technology	OEC	3	0	0	3	3
7.	OEC2403	VLSI Design	OEC	3	0	0	3	3
8	OEC2404	Remote Sensing Concepts	OEC	3	0	0	3	3
9.	OEC2405	Drone technologies	OEC	3	0	0	3	3
10.	OEE2402	Baiscs of Electric Vehicle Technology	OEC	3	0	0	3	3

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11.	OEE2403	Introduction To Control Systems	OEC	3	0	0	3	3
12.	OEE2404	Integrated energy planning for sustainable development	OEC	3	0	0	3	3
13.	OHS2401	Nano technology	OEC	3	0	0	3	3
14.	OHS2402	Operations research	OEC	3	0	0	3	3
15.	OME2407	Additive Manufacturing	OEC	3	0	0	3	3

MANDATORY COURSE - I (SOCIETY)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX24101	Introduction to women gender and studies	MC	3	0	0	3	0
2.	MX24102	Elements of literature	MC	3	0	0	3	0
3.	MX24103	Disaster risk reduction and management	MC	3	0	0	3	0
4.	MX24104	History of science and technology in india	MC	3	0	0	3	0
5.	MX24105	State, nation building and politics in india	MC	3	0	0	3	0
6.	MX24106	Political and economic thought for a humane society	MC	3	0	0	3	0
7.	MX24107	Understanding Society & Culture through Literature	MC	3	0	0	3	0
8.	MX24108	Work Ethics & Social Responsibilty	MC	3	0	0	3	0
9.	MX24109	Technology & Society	MC	3	0	0	3	0
10.	MX24110	Social Innovation & Entrepreneurship	MC	3	0	0	3	0
11.	MX24111	Education & Social Change	MC	3	0	0	3	0

MANDATORY COURSE - II (HEALTH AND WELL BEING)

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. S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX24201	Industrial Safety	MC	3	0	0	3	0
2.	MX24202	Well Being with Traditional Practices - Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
3.	MX24203	Application of Psychology in Everyday Life	MC	3	0	0	3	0
4.	MX24204	Stress Management and Well Being	MC	3	0	0	3	0
5.	MX24205	Health and Well Being in Education	MC	3	0	0	3	0
6.	MX24206	Physical fitness & Mental Resilience	MC	3	0	0	3	0
7.	MX24207	Food, Nutrition and Health	MC	3	0	0	3	0
8.	MX24208	Life style diseases	MC	3	0	0	3	0

MANAGEMENT ELECTIVES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE24M01	Principles of Management	HSMC	3	0	0	3	3
2.	GE24M02	Total Quality Management	HSMC	3	0	0	3	3
3.	GE24M03	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE24M04	Human Resource Management	HSMC	3	0	0	3	3
5.	GE24M05	Knowledge Management	HSMC	3	0	0	3	3
6.	GE24M06	Industrial Management	HSMC	3	0	0	3	3

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7.	GE24M07	Foundations of entrepreneurship	HSMC	3	0	0	3	3

SEMESTER- I

Subject Code	Subject Name	Category	L	T	P	C
IP24101	**INDUCTION PROGRAMME**		**0**	**0**	**0**	**0**

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

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(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and

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get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme

References:
Guide to Induction program from AICTE

Subject Code	Subject Name	Category	L	T	P	C
HS24101	**PROFESSIONAL ENGLISH- I**	**HSMC**	**3**	**0**	**0**	**3**

Course Objectives:

- To improve the communicative competence of learners
- To learn to use basic grammatic structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners' ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT – I	**INTRODUCTION TO EFFECTIVE COMMUNICATION**	**1**

What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C's of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	**8**

Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Wh/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT – II	**NARRATION AND SUMMATION**	**9**

Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel &

technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar –Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.		
UNIT – III	**DESCRIPTION OF A PROCESS / PRODUCT**	**9**
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).		
UNIT – IV	**CLASSIFICATION AND RECOMMENDATIONS**	**9**
Reading – Newspaper articles; Journal reports –and Non Verbal Communcation (tables, pie charts etc,). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from nonverbal (chart , graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.		
UNIT – V	**EXPRESSION**	**9**
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.		
		Total Contact Hours : 45

Course Outcomes:	At the end of the course learners will be able
CO1:	To use appropriate words in a professional context
CO2:	To gain understanding of basic grammatical structures and use them in right context.
CO3:	To read and infer the denotative and connotative meanings of technical texts
CO4:	To write definitions, descriptions, narrations and essays on various topics

Textbooks:	
1.	English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2.	English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

Reference books/other materials/webresources:	
1.	Technical Communication – Principles And Practices By Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi
2.	A Course Book On Technical English By Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.

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3.	English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education, ISBN : 0070264244.
4.	Effective Communication Skill, Kulbhusan Kumar, RS Salaria, Khanna Publishing House. 5. Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.
5.	Learning to Communicate – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	1	1	1	1	1	3	3	3	1	3	-	-	-	-
CO2:	1	1	1	1	1	3	3	3	1	3	-	-	-	-
CO3:	2	3	2	3	2	3	3	3	2	3	3	-	-	-
CO4:	2	3	2	3	2	3	3	3	2	3	3	-	-	-
CO5:	2	3	3	3	-	3	3	3	2	3	-	-	-	-
Average:	**1.6**	**2.2**	**1.8**	**2.2**	**1.5**	**3**	**3**	**3**	**1.6**	**3**	**3**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
MA24101	**MATRICES AND CALCULUS**	**BSC**	**3**	**1**	**0**	**4**

Course Objectives:

- To develop the use of matrix algebra techniques that are needed by engineers for practical applications
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications

UNIT – I	**MATRICES**	**9+3**
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.		
UNIT – II	**DIFFERENTIAL CALCULUS**	**9+3**

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Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.		
UNIT – III	**FUNCTIONS OF SEVERAL VARIABLES**	**9+3**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.		
UNIT – IV	**INTEGRAL CALCULUS**	**9+3**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration : Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications : Hydrostatic force and pressure, moments and centres of mass.		
UNIT – V	**MULTIPLE INTEGRALS**	**9+3**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.		
		Total Contact Hours : 60

Course Outcomes:	At the end of the course the students will be able to:
CO1:	Use the matrix algebra methods for solving practical problems.
CO2:	Apply differential calculus tools in solving various application problems.
CO3:	Able to use differential calculus ideas on several variable functions.
CO4:	Apply different methods of integration in solving practical problems.
CO5:	Apply multiple integral ideas in solving areas, volumes and other practical problems.

Textbooks:	
1.	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10thEdition, New Delhi, 2016.
2.	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44thEdition , 2018.
3.	James Stewart, " Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11,4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

Reference Books/Other Materials/Web Resources:	
1.	Anton. H, Bivens. I and Davis. S, "Calculus", Wiley, 10th Edition, 2016
2.	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7thEdition, 2009.
3.	Jain . R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5thEdition, 2016.
4.	Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan

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	Publishers Pvt. Ltd., Chennai, 2009.
5.	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6.	Srimantha Pal and Bhunia. S.C, “Engineering Mathematics" Oxford University Press, 2015.
7.	Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	1	1	-	-	-	2	-	2	3	-	-	-
CO2:	3	3	1	1	-	-	-	2	-	2	3	-	-	-
CO3:	3	3	1	1	-	-	-	2	-	2	3	-	-	-
CO4:	3	3	1	1	-	-	-	2	-	2	3	-	-	-
CO5:	3	3	1	1	-	-	-	2	-	2	3	-	-	-
Average:	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
PH24101	**ENGINEERING PHYSICS**	**BSC**	**3**	**0**	**0**	**3**

Course Objectives:

- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I	**MECHANICS**	**9**
Multiparticle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum – double pendulum –Introduction to nonlinear oscillations.		
UNIT II	**ELECTROMAGNETIC WAVES**	**9**
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	**OSCILLATIONS, OPTICS AND LASERS**	**9**

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Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave - sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference –Michelson interferometer –Theory of air wedge and experiment.Theory of laser - characteristics- Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		Total Contact Hours : 45

Course Outcomes:	After completion of this course students should be able to:
CO1:	Understand the importance of mechanics.
CO2:	Express their knowledge in electromagnetic waves.
CO3:	Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
CO4:	Understand the importance of quantum physics.
CO5:	Comprehend and apply quantum mechanical principles towards the formation of energy bands.

Textbooks:	
1.	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
2.	E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.
3.	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, Concepts of Modern Physics, McGraw- Hill (Indian Edition), 2017.

Reference books/other materials/webresources:	
1.	R.Wolfson. Essential University Physics. Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2.	Paul A. Tipler, Physic – Volume 1 & 2, CBS, (Indian Edition), 2004.
3.	K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications, Laxmi Publications, (Indian Edition), 2019.

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4.	D.Halliday, R.Resnick and J.Walker. Principles of Physics, Wiley (Indian Edition), 2015.
5.	N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	1	1	1	-	-	-	-	-	-	-	-
CO2:	3	3	2	1	2	1	-	-	-	-	-	-	-	-
CO3:	3	3	2	2	2	1	-	-	-	-	1	-	-	-
CO4:	3	3	1	1	2	1	-	-	-	-	-	-	-	-
CO5:	3	3	1	1	2	1	-	-	-	-	-	-	-	-
Average:	**3**	**3**	**1.6**	**1.2**	**1.8**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CY24101	**ENGINEERING CHEMISTRY**	**BSC**	**3**	**0**	**0**	**3**

Course Objectives:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT– I	**WATER AND ITS TREATMENT**	**9**

Water: Sources and impurities, Water quality parameters: Definition and significance of-color, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. Municipal water treatment: primary treatment and disinfection (UV, Ozonation, break-point chlorination). Desalination of brackish water: Reverse Osmosis. Boiler troubles: Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. Treatment of boiler feed water: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT– II	**NANOCHEMISTRY**	**9**

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Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.		
UNIT– III	**PHASE RULE AND COMPOSITES**	**9**
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.		
UNIT – IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO2 emission and carbon footprint.		
UNIT – V	**ENERGY SOURCESAND STORAGE DEVICES**	**9**
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion battery; Electric vehicles - working principles; Fuel cells: H2-O2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.		
		Total Contact Hours : 45

Course Outcomes:	At the end of the course,the students will be able :
CO1:	To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
CO2:	To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
CO3:	To apply the knowledge of phase rule and composites for material selection requirements.
CO4:	To recommend suitable fuels for engineering processes and applications.
CO5:	To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

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Textbooks:	
1.	P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3.	S.S. Dara, "A Text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018

Reference Books/Other Materials/Web Resources:	
1.	B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2.	O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3.	Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4.	ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.
5.	O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2nd Edition, 2013.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	1	-	1	-	-	-	-	1	-	-	-
CO2:	2	-	-	1	-	2	-	-	-	-	-	-	-	-
CO3:	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4:	3	1	1	-	-	1	-	-	-	-	-	-	-	-
CO5:	3	1	2	1	-	2	-	-	-	-	2	-	-	-
Average:	**2.8**	**1.3**	**1.6**	**1**	**-**	**1.5**	**-**	**-**	**-**	**-**	**1.5**	**-**	**-**	**-**

Subject Code	Subject Name	Category	L	T	P	C
GE24101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**ESC**	**3**	**0**	**0**	**3**

Course Objectives:

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT– I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

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Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.		
UNIT– II	**DATA TYPES, EXPRESSIONS, STATEMENTS**	**9**
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string , and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT– III	**CONTROL FLOW, FUNCTIONS, STRINGS**	**9**
Conditionals:Boolean values and operators, conditional (if), alternative (if-else),chained conditional (if-elif-else);Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion; Strings: string slices,immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT – IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT – V	**FILES, MODULES, PACKAGES**	**9**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
		Total Contact Hours : 45

Textbooks:	
1.	Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.

Reference Books/Other Materials/Web Resources:	
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2.	G. Venkatesh and MadhavanMukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3.	John V. Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.
4.	Eric Matthes, "Python Crash Course: A Hands-on, Project-Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	https://www.python.org/

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6.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, McGraw-Hill, 2018.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO2:	3	3	3	3	2	-	-	-	-	2	2	3	-	-
CO3:	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4:	2	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5:	1	2	-	-	1	-	-	-	-	1	-	2	-	-
CO6:	2	2	-	-	2	-	-	-	-	1	-	2	-	-
Average:	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24102	**HERITAGE OF TAMILS**	**HSMC**	**1**	**0**	**0**	**1**

Course Objectives:

- To appreciate Tamil art, culture and literature
- To learn the history and culture of Tamil language
- To relate to various art forms and their relevance to development
- To acknowledge the rich heritage and significant achievements of the Tamilians
- To appreciate the contribution of Tamilians to nation building

UNIT– I	**LANGUAGE AND LITERATURE**	**3**
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.		
UNIT– II	**HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE**	**3**
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.		
UNIT– III	**FOLK AND MARTIAL ARTS**	**3**
Therukoothu, Karagattam, VilluPattu, KaniyanKoothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.		
UNIT – IV	**THINAI CONCEPT OF TAMILS**	**3**

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Flora and Fauna of Tamils &Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.		
UNIT – V	**CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**	**3**
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.		
		Total Contact Hours : 15

Text- cum- Reference Books:	
1.	தமிழகவரலாறு - மக்களும்பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித்தமிழ் - முனைவர்இள. சுந்தரம் (விகடன்பிரசுரம்).
3.	கீழடி - வழிகாட்டும் நிழல்களில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு).
4.	பொருனந - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24102	**தமிழர் மரபு**	**HSMC**	**1**	**0**	**0**	**1**

அலகு- 1	**மொழி மற்றும் இலக்கியம்**	**3**
இந்திய மொழிக்குடும்பங்கள்– திரொவிடமொழிகள்– தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச்சார்பற்றதன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் –தமிழ்க்காப்பியங்கள் , தமிழகத்தில் சமண-பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்– சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில்		

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பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு		
அலகு- 2	**மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை சிற்பக்கலை**	**3**
நடுகல் முதல் நவீன சிற்பங்கள் வரை– ஐம்பொன்சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள் – தேர்வு செய்யும்கலை– சுடுமண்சிற்பங்கள்– நாட்டுப்புறத்தெய்வங்கள்– குமரிமுனையில்திருவள்ளுவர்சிலை– இசைகருவிகள்– மிருதங்கம் , பறை , வீணை , யாழ் , நாதஸ்வரம்– தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.		
அலகு -3	**நாட்டுப்புறக்கலைகள் மற்றும் வீரவிளையாட்டுகள்**	**3**
தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான்கூத்து, ஒயிலாட்டம் , தோல்பாவைக்கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின்விளையாட்டுகள்.		
அலகு -4	**தமிழர்களின் திணைக்கோட்பாடுகள்**	**3**
தமிழகத்தின் தாவரங்களும் , விலங்குகளும்– தொல்காப்பியம் மற்றும் சங்கஇலக்கியத்தில் அகம் மற்றும் புறக்கோட்பாடுகள்– தமிழர்கள் போற்றிய அறக்கோட்பாடு– சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும்– சங்ககாலநகரங்களும் துறைமுகங்களும்– சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி– கடல் கடந்தநாடுகளில் சோழர்களின் வெற்றி		
அலகு -5	**இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு**	**3**
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு– இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப்பண்பாட்டின் தாக்கம்– சுயமரியாதையை இயக்கம்– இந்திய மருத்துவத்தில் சித்தமருத்துவத்தின் பங்கு– கல்வெட்டுகள் கையழுத்துப்படிகள்– தமிழ் புத்தகங்களின் அச்சுவரலாறு		
		Total Contact Hours : 15

Text- cum- Reference Books:	
1.	தமிழகவரலாறு – மக்களும்பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்).
2.	கணினித்தமிழ் – முனைவர்இள. சுந்தரம் (விகடன்பிரசுரம்).
3.	கீழடி – வழிகாட்டும்நிழல்களில்சங்ககாலநகரநாகரிகம் (தொல்லியல்துறைவெளியீடு).
4.	பொருனை – ஆற்றங்கரைநாகரிகம். (தொல்லியல்துறைவெளியீடு).
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by:

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	The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Subject Code	Subject Name	Category	L	T	P	C
GE24111	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**ESC**	**0**	**0**	**4**	**2**

Course Objectives:

- To understand the problem-solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real-world problems.
- To use Python data structures such as lists, tuples, and dictionaries.
- To perform input/output operations with files in Python.

EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

LABORATORY / PRACTICAL ACTIVITIES

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

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	Total Contact Hours :60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Develop algorithmic solutions to simple computational problems.
CO2:	Develop and execute simple Python programs.
CO3:	Implement Python programs using conditionals and loops to solve real-world problems.
CO4:	Deploy functions to decompose a Python program.
CO5:	Process compound data using Python data structures.
CO6:	Utilize Python packages in developing software applications.

Textbooks:	
1.	Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2.	Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
Reference books/other materials/web resources:	
1.	Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2.	G. Venkatesh and MadhavanMukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3.	John V. Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.
4.	Eric Matthes, "Python Crash Course: A Hands-on, Project-Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5.	Martin C. Brown, "Python: The Complete Reference", 4th Edition, McGraw-Hill, 2018
6.	https://www.python.org/

.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	2	-	-	-	-	2	2	3	3	-
CO2:	3	3	3	3	2	-	-	-	-	2	2	3	-	-
CO3:	3	3	3	3	2	-	-	-	-	2	-	3	-	-
CO4:	2	2	-	2	2	-	-	-	-	1	-	3	-	-
CO5:	1	2	-	-	1	-	-	-	-	1	-	2	-	-
CO6:	2	2	-	-	2	-	-	-	-	1	-	2	-	-

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Average:	**2**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
BS24111	**PHYSICS AND CHEMISTRY LABORATORY**	**BSC**	**0**	**0**	**4**	**2**

PHYSICS LABORATORY:(Any Seven Experiments)

Course Objectives:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS:	
1.	Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2.	Simple harmonic oscillations of cantilever.
3.	Non-uniform bending - Determination of Young's modulus
4.	Uniform bending – Determination of Young's modulus
5.	Laser- Determination of the wavelength of the laser using grating
6.	Air wedge - Determination of thickness of a thin sheet/wire
7.	a) Optical fibre -Determination of Numerical Aperture and acceptance angle
	b) Compact disc- Determination of width of the groove using laser.
8.	Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9.	Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10.	Post office box -Determination of Band gap of a semiconductor.
11.	Photoelectric effect
12.	Michelson Interferometer.
13.	Melde's string experiment
14.	Experiment with lattice dynamics kit.
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the functioning of various physics laboratory equipment.
CO2:	Use graphical models to analyze laboratory data.
CO3:	Use mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4:	Access, process and analyze scientific information.

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CO5:	Solve problems individually and collaboratively.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	1	1	-	-	-	-	-	-	-	-	-
CO2:	3	3	2	1	1	-	-	-	-	-	-	-	-	-
CO3:	3	2	3	1	1	-	-	-	-	-	-	-	-	-
CO4:	3	3	2	1	1	-	-	-	-	-	-	-	-	-
CO5:	3	2	3	1	1	-	-	-	-	-	-	-	-	-
Average:	**3**	**2.4**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

CHEMISTRY LABORATORY:(Any seven experiments to be conducted)

Course Objectives:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, dissolved oxygen (DO), chloride, and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.

Laboratory / Practical Activities:

1. Preparation of (Na_2CO_3) as a primary standard and Estimation of acidity of a water sample using the prepared primary standard.
2. Determination of types and amount of alkalinity in a water sample.
3. Determination of total, temporary, and permanent hardness of water by EDTA method.
4. Determination of DO content of a water sample by Winkler's method.
5. Determination of chloride content of a water sample by Argentometric method.
6. Estimation of copper content in the given solution by Iodometry.
7. Estimation of total dissolved solids (TDS) of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using a pH meter.
9. Determination of strength of acids in a mixture using a conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
11. Estimation of iron content in a given solution using a potentiometer.
12. Estimation of sodium or potassium present in water using a flame photometer.
13. Preparation of nanoparticles (TiO_2 / ZnO / CuO) by Sol-Gel method.
14. Estimation of nickel in steel.
15. Proximate analysis of coal.

Total Contact Hours : 30

Course Outcomes:	Upon completion of the course,the students should be able to:

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CO1:	To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2:	To determine the amount of metal ions through volumetric and spectroscopic techniques
CO3:	To analyse and determine the composition of alloys.
CO4:	To learn simple method of synthesis of nanoparticles
CO5:	To quantitatively analyse the impurities in solution by electroanalytical techniques

Textbooks:	
1.	J. Mendham.,R.C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogfel's Textbook of Qualitative Chemical Anaysis, 2009.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	-	1	-	-	2	-	-	-	-	2	-	-	-
CO2:	3	1	2	-	-	1	-	-	-	-	1	-	-	-
CO3:	3	2	1	1	-	-	-	-	-	-	-	-	-	-
CO4:	2	1	2	-	-	2	-	-	-	-	-	-	-	-
CO5:	2	1	2	-	1	2	-	-	-	-	1	-	-	-
Average:	**2.6**	**1.3**	**1.6**	**1**	**1**	**1.4**	**-**	**-**	**-**	**-**	**1.3**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24112	**ENGLISH LABORATORY**	**EEC**	**0**	**0**	**2**	**1**

Course Objectives:

- To improve the communicative competence of learners
- To help learners use language effectively in academic /work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT– I	**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**	**6**
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; -politeness strategies-making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions(filling out a bank application for example).		
UNIT– II	**NARRATION AND SUMMATION**	**6**

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Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.		
UNIT– III	**DESCRIPTION OF A PROCESS / PRODUCT**	**6**
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description- describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)-talking about precautions.		
UNIT – IV	**CLASSIFICATION AND RECOMMENDATIONS**	**6**
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress- talking about positions and directions of movement-talking about travel preparations- talking about transportation		
UNIT – V	**EXPRESSION**	**6**
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions- understanding a website- describing processes		
		Total Contact Hours :30

Course Outcomes:	At the end of the course,learners will be able
CO1:	To listen to and comprehend general as well as complex academic information
CO2:	To listen to and understand different points of view in a discussion
CO3:	To speak fluently and accurately in formal and informal communicative contexts
CO4:	To describe products and processes and explain their uses and purposes clearly and accurately
CO5:	To express their opinions effectively in both formal and informal discussions

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO2:	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO3:	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO4:	3	3	3	3	1	3	3	3	3	3	3	-	-	-
CO5:	3	3	3	3	1	3	3	3	3	3	3	-	-	-
Average:	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

SEMESTER- II

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Subject Code	Subject Name	Category	L	T	P	C
HS24201	**PROFESSIONAL ENGLISH – II**	**HSMC**	**2**	**0**	**0**	**2**

Course Objectives:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT – I	**MAKING COMPARISONS**	**6**
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay; Grammar – Mixed Tenses, Prepositional phrases		
UNIT – II	**EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING**	**6**
Reading - Reading longer technical texts– Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds		
UNIT – III	**PROBLEM SOLVING**	**6**
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences		
UNIT – IV	**REPORTING OF EVENTS AND RESEARCH**	**6**
Reading –Newspaper articles; Writing – Recommendations, Transcoding, Accident Report, Survey Report Grammar – Reported Speech, Modals Vocabulary – Conjunctions- use of prepositions		
UNIT – V	**THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY**	**6**
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.		
		Total Contact Hours : 30

Course Outcomes:	Upon completion of the course students should be able to:

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CO1:	To compare and contrast products and ideas in technical texts.
CO2:	To identify and report cause and effects in events, industrial processes through technical texts
CO3:	To analyse problems in order to arrive at feasible solutions and communicate them in the written format.
CO4:	To present their ideas and opinions in a planned and logical manner
CO5:	To draft effective resumes in the context of job search.

Textbooks:	
1.	English for Engineers &Technologists(2020edition)Orient Blackswan P rivate Ltd. Department of English, Anna University
2.	English for Science & Technology Cambridge University Press 2021
3.	Authored by Dr. Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

Reference Books/Other Materials/Web Resources:	
1.	Raman. Meenakshi, Sharma. Sangeeta (2019). Professional English. Oxford university press. New Delhi.
2.	Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, NewDelhi.
3.	Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4.	Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5.	Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO2:	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO3:	3	3	3	3	3	3	3	2	3	3	3	-	-	-
CO4:	3	3	3	3	2	3	3	2	3	3	3	-	-	-
CO5:	-	-	-	-	-	-	-	3	3	3	3	-	-	-
Average:	**3**	**3**	**3**	**3**	**2.75**	**3**	**3**	**2.2**	**3**	**3**	**3**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**

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MA24201	STATISTICS AND NUMERICAL METHODS	BSC	3	1	0	4

Course Objectives:

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT – I	TESTING OF HYPOTHESIS	9+3

Sampling distributions - Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT – II	DESIGN OF EXPERIMENTS	9+3

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - 22 factorial design.

UNIT – III	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	9+3

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	9+3

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT – V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	9+3

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

Total Contact Hours : 60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO2:	Apply the basic concepts of classifications of design of experiments in the field of agriculture.

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CO3:	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO4:	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5:	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

Textbooks:	
1.	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2.	Johnson, R.A., Miller, I and Freund J., “Miller and Freund’s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books/Other Materials/Web Resources:	
1.	Burden, R.L and Faires, J.D, "Numerical Analysis”, 9th Edition, Cengage Learning, 2016.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences”, Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis” Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4.	Gupta S.C. and Kapoor V. K., “Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6.	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., “Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	1	1	1	-	-	2	-	2	3	-	-	-
CO2:	3	3	1	1	1	-	-	2	-	2	3	-	-	-
CO3:	3	3	1	1	1	-	-	2	-	2	3	-	-	-
CO4:	3	3	1	1	1	-	-	2	-	2	3	-	-	-
CO5:	3	3	1	1	1	-	-	2	-	2	3	-	-	-
Average:	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
PH24203	**PHYSICS FOR INFORMATION SCIENCE**	**BSC**	**3**	**0**	**0**	**3**

Course Objectives:

- To make the students understand the importance in studying electrical properties ofmaterials

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• To enable the students to gain knowledge in semiconductor physics
• To instill knowledge on magnetic properties of materials.
• To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
• To inculcate an idea of significance of nano structures, quantum confinement, ensuingnano device applications and quantum computing.

UNIT – I	**ELECTRICAL PROPERTIES OF MATERIALS**	**9**
Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression – Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass — concept of hole		
UNIT – II	**SEMI CONDUCTOR PHYSICS**	**9**
Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect and devices – Ohmic contacts — Schottky diode		
UNIT – III	**MAGNETIC PROPERTIES OF MATERIALS**	**9**
Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism — para magnetism — ferromagnetism — antiferro magnetism – ferri magnetism – Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-– Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).		
UNIT – IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storagetechniques.		
UNIT – V	**NANODEVICES AND QUANTUM COMPUTING**	**9**
Introduction - quantum confinement – quantum structures: quantum wells, wires and dots — band gap of nanomaterials. Tunneling – Single electron phenomena: Coulomb blockade - resonant-tunneling diode – single electron transistor – quantum cellular automata - Quantum system for		

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information processing - quantum states – classical bits – quantum bits or qubits – CNOT gate - multiple qubits – Bloch sphere – quantum gates – advantage of quantum computing over classical computing	
	Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Gain knowledge on classical and quantum electron theories, and energy band structures
CO2:	Acquire knowledge on basics of semiconductor physics and its applications in various devices
CO3:	Get knowledge on magnetic properties of materials and their applications in data storage,
CO4:	Have the necessary understanding on the functioning of optical materials for optoelectronics
CO5:	Understand the basics of quantum structures and their applications and basics of quantum computing

Text Books:	
1.	Jasprit Singh, "Semiconductor Devices: Basic Principles", Wiley (Indian Edition), 2007
2.	S.O. Kasap. Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition), 2020
3.	Parag K. Lala, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition), 2020

Reference books/other materials/web resources:	
1.	Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2.	Y.B.Band and Y.Avishai, Quantum Mechanics with Applications to Nanotechnology and Information Science, Academic Press, 2013.
3.	V.V.Mitin, V.A. Kochelap and M.A.Stroscio, Introduction to Nanoelectronics, Cambridge Univ.Press, 2008.
4.	G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.
5.	B.Rogers, J.Adams and S.Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2014.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	-	-	-	-	-	-	-	-	-	-	-	-
CO2:	3	1	2	-	-	-	-	-	-	-	-	-	-	-
CO3:	3	-	-	1	2	1	-	-	-	-	-	-	-	-
CO4:	3	-	2	1	3	-	-	-	-	-	-	-	-	-
CO5:	3	2	2	2	2	1	-	-	-	-	2	-	-	-

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Average:	**3**	**1.3**	**2**	**1.3**	**2.3**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
BE24201	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	**ESC**	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT – I	**ELECTRICAL CIRCUITS**	**9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT – II	**ELECTRICAL MACHINES**	**9**

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT – III	**ANALOG ELECTRONICS**	**9**

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters

UNIT – IV	**DIGITAL ELECTRONICS**	**9**

Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only).

UNIT – V	**MEASUREMENTS AND INSTRUMENTATION**	**9**

Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

Total Contact Hours : 45

Course Outcomes:	After completing this course, the students will be able to
CO1:	Compute the electric circuit parameters for simple problems
CO2:	Explain the working principle and applications of electrical machines
CO3:	Analyze the characteristics of analog electronic devices
CO4:	Explain the basic concepts of digital electronics

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CO5:	Explain the operating principles of measuring instruments

Textbooks:	
1.	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, Mc Graw Hill Education, 2020
2.	S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017
3.	Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4.	James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5.	A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Mesurements& Instrumentation', Dhanpat Rai and Co, 2015.

Reference Books/Other Materials/Web Resources:	
1.	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2.	Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017
3.	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.
4.	Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5.	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	2	1	-	-	-	1	-	-	-	2	-	-	1
CO2:	2	2	1	-	-	-	1	-	-	-	2	-	-	1
CO3:	2	1	1	-	-	-	1	-	-	-	2	-	-	1
CO4:	2	2	1	-	-	-	1	-	-	-	2	-	-	1
CO5:	2	2	1	-	-	-	1	-	-	-	2	-	-	1
Average:	**2**	**1.8**	**1**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**-**	**-**	**1**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24201	**ENGINEERING GRAPHICS**	**ESC**	**2**	**0**	**4**	**4**

Course Objectives:

The main learning objective of this course is to prepare the students for:

- Drawing engineering curves.
- Drawing a freehand sketch of simple objects.
- Drawing orthographic projection of solids and section of solids.
- Drawing development of solids.
- Drawing isometric and perspective projections of simple solids.

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CONCEPTS AND CONVENTIONS (Not for Examination)

Importance of graphics in engineering applications — Use of drafting instruments — BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT –I	**PLANE CURVES**	**6+12**
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.		
UNIT – II	**PROJECTION OF POINTS,LINES AND PLANE SURFACE**	**6+12**
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.		
UNIT–III	**PROJECTION OF SOLIDS AND FREEHAND SKETCHING**	**6+12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles —Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)		
UNIT– IV	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**6+12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)		
UNIT – V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**6+12**
Principles of isometric projection — isometric scale — isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids - Prisms, pyramids and cylinders by visual ray method. Practicing three dimensional modeling of isometric projection of simple objects by CAD software(Not for examination)		
		Total Contact Hours :(L=30+P=60) 90

Course Outcomes:	On Successful completion of this course, students should be able to
CO1:	Use BIS conventions and specifications for engineering drawing.
CO2:	Construct the conic curves,involutes and cycloid
CO3:	Solve practical problems involving projection of lines
CO4:	Draw the orthographic,isometric and perspective projections of simple solids.
CO5:	Draw the development of simple solids.

Textbooks:

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1.	Bhatt N.D. and Panchal V.M.,"Engineering Drawing", Charotar Publishing House,53rd Edition,2019
2.	NatrajanK.V.,"ATextBook of Engineering Graphics",Dhanalakshmi Publishers, Chennai, 2018.
3.	Parthasarathy,N.S.andVela Murali,"Engineering Drawing",Oxford University Press,2015

Reference Books/Other Materials/Web Resources:	
1.	Basant Agarwal and Agarwal C.M., "Engineering Drawing", McGraw Hill, 2nd Edition, 2019.
2.	GopalakrishnaK.R.,"EngineeringDrawing"(Vol.I&IIcombined),SubhasPublications,Bangalore,27th Edition,2017.
3.	Luzzader,Warren.J.andDuff,JohnM.,"FundamentalsofEngineeringDrawingwithanintroduction toInteractiveComputerGraphicsforDesignandProduction,EasternEconomyEdition,Prentice Hall ofIndia Pvt. Ltd, NewDelhi,2005.
4.	Parthasarathy N. S. and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5.	Shah M.B., and Rana B.C., "Engineering Drawing", Pearson Education India, 2nd Edition, 2009.
6.	Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 — 2001: Technical products Documentation — Size and layout of drawing sheets.
2. IS 9609 (Parts 0 & 1) — 2001: Technical products Documentation — Lettering.
3. IS 10714 (Part 20) — 2001 & SP 46 — 2003: Lines for technical drawings.
4. IS 11669 — 1986 & SP 46 —2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) — 2001: Technical drawings — Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

There will be five questions, each of either or type covering all units of the syllabus.

1. All questions will carry equal marks of 20 each making a total of 100.
2. The answer paper shall consist of drawing sheets of A3 size only.
3. The students will be permitted to use appropriate scale to fit a solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO2:	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO3:	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO4:	3	1	2	-	2	-	-	-	3	-	2	2	2	-
CO5:	3	1	2	-	2	-	-	-	3	-	2	2	2	-
Average:	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**

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Subject Code	Subject Name	Category	L	T	P	C
AD24201	DATA STRUCTURES DESIGN	PCC	3	0	0	3

Course Objectives:

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

UNIT -I	**ABSTRACT DATA TYPES**	**9**

Abstract Data Types (ADTs) – ADTs and classes – introduction to OOP – classes in Python inheritance – namespaces – shallow and deep copying Introduction to analysis of algorithms – asymptotic notations – recursion – analyzing recursive algorithms

UNIT – II	**LINEAR STRUCTURES**	**9**

ListADT–array-basedimplementations–linkedlistimplementations–singlylinkedlists–circularly linked lists – doubly linked lists – applications of lists – Stack ADT – Queue ADT – double ended queues

UNIT – III	**SORTING AND SEARCHING**	**9**

Bubblesort–selectionsort–insertionsort–mergesort–quicksort–linearsearch–binarysearch –hashing –hash functions – collision handling – load factors, rehashing, and efficiency

UNIT – IV	**TREE STRUCTURES**	**9**

Tree ADT – Binary Tree ADT – tree traversals – binary search trees – AVL trees – heaps – multi- way search trees.

UNIT – V	**GRAPH STRUCTURES**	**9**

Graph ADT – representations of graph – graph traversals – DAG – topological ordering – shortest paths – minimum spanning trees.

Total Contact Hours : 45

Course Outcomes:	At the end of the course, students should be able to:
CO1:	Explain abstract data types
CO2:	Design ,implement and analyse linear data structures, such as lists, queues, and stacks, according to the needs of different applications
CO3:	Design, implement and analyze linear data structures, such as lists, queues and stacks according to the needs of different applications
CO4:	Model problems as graph problems and implement efficient graph algorithms to solve them

Textbooks:

1.	Michael T. Goodrich, Roberto Tamassia, andMichael H. Goldwasser, “Data Structures and Algorithms in Python” (An Indian Adaptation), Wiley, 2021
2.	Lee,KentD.,Hubbard,Steve,“DataStructures and Algorithms with Python”Springer Edition 2015..
3.	Narasimha Karumanchi, “Data Structures and Algorithmic Thinking with Python” Careermonk, 2015.

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Reference Books/Other Materials/Web Resources:	
1.	RanceD. Necaise,“Data Structures and Algorithms Using Python”,John Wiley & Sons,2011.
2.	ThomasH.Cormen,CharlesE.Leiserson,RonaldL.Rivest,andCliffordStein,“Introduction to Algorithms", Third Edition, PHI Learning, 2010.
3.	MarkAllen Weiss,“Data Structures and Algorithm Analysis in C++”,Fourth Edition,Pearson Education, 2014
4.	Aho,Hopcroft,andUllman,“DataStructuresandAlgorithms”,PearsonEducationIndia, 2002

Subject Code	Subject Name	Category	L	T	P	C
GE24202	**TAMILS AND TECHNOLOGY**	**HSMC**	**1**	**0**	**0**	**1**

UNIT – I	**WEAVING AND CERAMIC TECHNOLOGY**	**3**
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3**
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3**
Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3**
Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3**
Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.		
	Total Contact Hours :15	

Text-cum-Reference Books	
1.	Dr. K.K. Pillay, “தமிழகவரலாறு – மக்களும்பண்பாடும்”, தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள்கழகம்.

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2.	இல. சுந்தரம், "கணினித்தமிழ்", விகடன்பிரசுரம்.
3.	அறுவைத்துறை – தொல்லியல்துறை, "கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம்", தமிழ்நாடு தொல்லியல் துறை & தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம் (தொல்லியல்துறைவெளியீடு).
4.	அறுவைத்துறை – தொல்லியல்துறை, "பொருணை – ஆற்றங்கரை நாகரிகம்", தமிழ்நாடு தொல்லியல் துறை.
5.	Dr. K.K. Pillay, "Social Life of Tamils", TNTB & ESC and RMRL (Joint Publication), [In Print].
6.	Dr. S. Singaravelu, "Social Life of the Tamils – The Classical Period", International Institute of Tamil Studies,
7.	Dr. S.V. Subramanian &Dr. K.D. Thirunavukkarasu, "Historical Heritage of the Tamils", International Institute of Tamil Studies
8.	Dr. M. Valarmathi, "The Contributions of the Tamils to Indian Culture", International Institute of Tamil Studies
9.	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, "Keeladi – Sangam City Civilization on the banks of river Vaigai", Joint Publication,
10.	Dr. K.K. Pillay, "Studies in the History of India with Special Reference to Tamil Nadu", Self Published by the Author,
11.	Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, "Porunai Civilization", Joint Publication,
12.	R. Balakrishnan, "Journey of Civilization: Indus to Vaigai", RojaMuthiah Research Library (RMRL),

Subject Code	Subject Name	Category	L	T	P	C
GE24202	**தமிழரும்தொழில்நுட்பமும்**	**HSMC**	1	0	0	1

அலகு- I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்:	**3**
சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.		
அலகு -II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	**3**

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சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.		
அலகு -III	**உற்பத்திதொழில்நுட்பம்**	**3**
கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.		
அலகு- IV	**வேளாண்மைமற்றும்நீர்ப்பாசனதொழில்நுட்பம்**	**3**
அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.		
அலகு -V	**அறிவியல்தமிழ்மற்றும்கணினித்தமிழ்**	**3**
அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.		
		Total Contact Hours : 15

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TEXT-CUM-REFERENCE BOOKS:	
1.	தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2.	கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3.	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4.	பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5.	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6.	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies
7.	Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies)
8.	The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: 36 Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10.	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11.	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12.	Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book

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Subject Code	Subject Name	Category	L	T	P	C
	NCC Credit Course Level 1* (ARMY WING) NCC Credit Course Level – I	**HSMC**	**2**	**0**	**0**	**2**

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours :30	

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Subject Code	Subject Name	Category	L	T	P	C
	NCC Credit Course Level 1* (NAVAL WING) NCC Credit Course Level – I	**HSMC**	**2**	**0**	**0**	**2**

NCC GENERAL		**6**
NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours :30	

Subject Code	Subject Name	Category	L	T	P	C
	NCC Credit Course Level 1* (AIR FORCE WING) NCC Credit Course Level – I	**HSMC**	**2**	**0**	**0**	**2**
NCC GENERAL						**6**

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NCC 1	Aims, Objectives & Organization of NCC	1
NCC 2	Incentives	2
NCC 3	Duties of NCC Cadet	1
NCC 4	NCC Camps: Types & Conduct	2
NATIONAL INTEGRATION AND AWARENESS		**4**
NI 1	National Integration: Importance & Necessity	1
NI 2	Factors Affecting National Integration	1
NI 3	Unity in Diversity & Role of NCC in Nation Building	1
NI 4	Threats to National Security	1
PERSONALITY DEVELOPMENT		**7**
PD 1	Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving	2
PD 2	Communication Skills	3
PD 3	Group Discussion: Stress & Emotions	2
LEADERSHIP		**5**
L 1	Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code	3
L 2	Case Studies: Shivaji, Jhasi Ki Rani	2
SOCIAL SERVICE AND COMMUNITY DEVELOPMENT		**8**
SS 1	Basics, Rural Development Programmes, NGOs, Contribution of Youth	3
SS 4	Protection of Children and Women Safety	1
SS 5	Road / Rail Travel Safety	1
SS 6	New Initiatives	2
SS 7	Cyber and Mobile Security Awareness	1
	Total Contact Hours :30	

Subject Code	Subject Name	Category	L	T	P	C
GE24211	**ENGINEERING PRACTICES LABORATORY**	**ESC**	**0**	**0**	**4**	**2**

Course Objectives:

The main learning objective of this course is to provide hands on training to the students in:

- Drawing pipeline plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planning; making joints in wood materials used in common household wood work
- Wiring various electrical joints in common household electrical wirework.

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• Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts ;Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work
• Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART – I	**CIVIL ENGINEERINGPRACTICES**	**15**

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planing and
c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

PART – II	**ELECTRICAL ENGINEERINGPRACTICES**	**15**

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/ calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater

GROUP – B (MECHANICAL AND ELECTRONICS)

PART – III	**MECHANICAL ENGINEERINGPRACTICES**	**15**

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WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air-conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART – IV	**ELECTRONIC ENGINEERING PRACTICES**	**15**

SOLDERINGWORK:

a) Soldering simple electronic circuits and checking continuity.

ELECTRONICASSEMBLY AND TESTINGWORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONICEQUIPMENTSTUDY:

a) Study the elements of smart phone.
b) Assembly and dismantle of LED TV.
c) Assembly and dismantle of computer/ laptop

	Total Contact Hours : 60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
CO2:	Wire various electrical joints in common household electrical wire work.
CO3:	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
CO4:	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

	CO-PO Mapping	**CO-PSO Mapping**

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PO & PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	3	2	-	-	-	1	-	-	-	-	2	2	1	1
CO2:	3	2	-	-	-	1	-	-	-	-	2	2	1	1
CO3:	3	2	-	-	-	1	-	-	-	-	2	2	1	1
CO4:	3	2	-	-	-	1	-	-	-	-	2	2	1	1
Average:	**3**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**1**

Subject Code	Subject Name	Category	L	T	P	C
AD24211	**DATA STRUCTURES DESIGN LABORATORY**	**PCC**	**0**	**0**	**4**	**2**

Course Objectives:

- To implement ADTs in Python
- To design and implement linear data structures–lists, stacks and queues
- To implement sorting, searching and hashing algorithms
- To solve problems using tree and graph structures

LIST OF EXPERIMENTS:

Note: The lab instructor is expected to design problems based on the topics listed. The Examination shall not be restricted to the sample experiments designed.

1. Implement simple ADTs as Python classes
2. Implement recursive algorithmsin Python
3. Implement List ADT using Pythonarrays
4. Linked list implementations of List
5. Implementation of Stack and Queue ADTs
6. Applications of List,Stack and Queue ADTs
7. Implementation of sorting and searching algorithms
8. Implementation of Hash tables
9. Tree representation and traversal algorithms
10. Implementation of Binary Search Trees
11. Implementation of Heaps
12. Graph representation and Traversal algorithms
13. Implementation of single source shortest path algorithm
14. Implementation of minimum spanning tree algorithms

Total Contact Hours :60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Implement ADTs as Python classes

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CO2:	Design,implement,andanalyselineardatastructures,suchaslists,queues,andstacks, according to the needs of different applications
CO3:	Design,implement,andanalyseefficienttreestructurestomeetrequirementssuch as searching, indexing, and sorting
CO4:	Model problems as graph problems and implement efficient graph algorithms to solve them

Textbooks:	
1.	Michael T. Goodrich, Roberto Tamassia, andMichael H. Goldwasser, "Data Structures and Algorithms in Python" (An Indian Adaptation), Wiley, 2021
2.	Lee,KentD.,Hubbard,Steve,"DataStructuresandAlgorithmswithPython"Springer Edition 2015
3.	Narasimha Karumanchi, "Data Structures and Algorithmic Thinking with Python" Career monk, 2015.

Reference Books/Other Materials/Web Resources:	
1.	RanceD.Necaise,"DataStructuresandAlgorithmsUsingPython",JohnWiley&Sons,2011.
2.	ThomasH.Cormen,CharlesE.Leiserson,RonaldL.Rivest,andCliffordStein,"Introduction to Algorithms", Third Edition, PHI Learning, 2010.
3.	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++",Fourth Edition, Pearson Education, 2014
4.	Aho,Hopcroft,and Ullman, "Data Structures and Algorithms" ,Pearson Education India, 2002.

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24212	**COMMUNICATION LABORATORY**	**EEC**	**0**	**0**	**4**	**2**

Course Objectives:

- To identify and apply group discussion skills to participate effectively in professional discussions.
- To analyse concepts and problems and deliver clear, concise, and effective presentations.
- To communicate proficiently through both formal and informal writing.
- To use appropriate language structures to write emails, reports, and essays.
- To give instructions and recommendations that are clear, contextually appropriate, and purposeful.

UNIT – I	**12**
Speaking-Role Play Exercises Based on Workplace Contexts, - talking about competition- discussing progress toward goals-talking about experiences- talking about events in life- discussing past events-	

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Writing: writing emails (formal& semi-formal).	
UNIT – II	**12**
Speaking: discussing news stories-talking about frequency-talking about travel problems- discussing travel procedures- talking about travel problems- making arrangements-describing arrangements-discussing plans and decisions- discussing purposes and reasons- understanding common technology terms-Writing: - writing different types of emails.	
UNIT – III	**12**
Speaking: discussing predictions-describing the climate-discussing forecasts and scenarios- talking about purchasing-discussing advantages and disadvantages- making comparisons- discussing likes and dislikes- discussing feelings about experiences-discussing imaginary scenarios Writing: short essays and reports-formal/semi-formal letters.	
UNIT – IV	**12**
Speaking: discussing the natural environment-describing systems-describing position and movement-explaining rules-(example- discussing rental arrangements)- understanding technical instructions-Writing: writing instructions-writing a short article.	
UNIT – V	**12**
Speaking: describing things relatively-describing clothing-discussing safety issues (making recommendations) talking about electrical devices-describing controlling actions- Writing: job application(Cover letter + Curriculum vitae)-writing recommendations.	
	Total Contact Hours :60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Speak effectively in group discussions held in a formal/semi formal contexts.
CO2:	Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions
CO3:	Write emails, letters and effective job applications.
CO4:	Write critical reports to convey data and information with clarity and precision
CO5:	Give appropriate instructions and recommendations for safe execution of tasks

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	3	3	3	1	3	3	3	3	3	3	-	-	-
CO2:	2	3	3	3	1	3	3	3	3	3	3	-	-	-
CO3:	2	2	3	3	1	3	3	3	3	3	3	-	-	-
CO4:	3	3	3	3	3	3	3	3	3	3	3	-	-	-
CO5:	3	3	3	3	3	3	3	3	3	3	3	-	-	-
Average:	**2.4**	**2.8**	**3**	**3**	**1.8**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**

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SEMESTER-III

Subject Code	Subject Name	Category	L	T	P	C
MA24301	DISCRETE MATHEMATICS	BSC	3	1	0	4

Course Objectives:

- To extend student's logical and mathematical maturity and ability to deal with abstraction
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and boolean algebra which are widely used in computer science and engineering.

UNIT – I	**LOGIC AND PROOFS**	**9+3**
Propositional logic – Propositional equivalences – Predicates – Rules of inference - Introduction to proofs – Proof methods and strategy.		
UNIT – II	**COMBINATORICS**	**9+3**
Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Inclusion and exclusion principle and its applications.		
UNIT – III	**GRAPHS**	**9+3**
Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton graphs.		
UNIT – IV	**ALGEBRAIC STRUCTURES**	**9+3**
Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem.		
UNIT – V	**LATTICES AND BOOLEAN ALGEBRA**	**9+3**
Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra		
		Total Contact Hours : 60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Have knowledge of the concepts needed to test the logic of a program
CO2:	Have an understanding in identifying structures on many levels.
CO3:	Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science
CO4:	Be aware of the counting principles
CO5:	Be exposed to concepts and properties of algebraic structures

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	such as groups, rings and fields.

Textbooks:	
1.	Rosen. K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2017.
2.	Tremblay. J.P. and Manohar. R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2011. 66

Reference books/other materials/webresources:	
1.	Grimaldi. R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5 th Edition, Pearson Education Asia, Delhi, 2013.
2.	Koshy. T. "Discrete Mathematics with Applications", Elsevier Publications, 2006
3.	Lipschutz. S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	-	-	-	-	-	-	-	2	-	-	-
CO2:	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3:	-	3	2	-	-	2	-	-	-	3	-	-	-	-
CO4:	-	2	2	2	-	-	-	-	-	-	-	-	-	-
CO5:	-	2	2	2	-	-	-	-	-	2	-	-	-	-
Average:	3	2.6	2	2	-	2	-	-	-	2.5	2	-	-	-

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CS24305	**DIGITAL PRINCIPLES AND COMPUTER ORGANIZATION**	**ESC**	**3**	**0**	**0**	**3**

Course Objectives:

- To analyze and design combinational circuits.
- To analyze and design sequential circuit.
- To understand the basic structure and operation of a digital computer.
- To study the design of data path unit, control unit for processor and to familiarize with the hazards.
- To understand the concept of various memories and I/O interfacing.

UNIT – I	**COMBINATIONAL LOGIC**	**9**

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Combinational Circuits – Karnaugh Map - Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder - Magnitude Comparator – Decoder – Encoder – Multiplexers - Demultiplexers		
UNIT – II	**SYNCHRONOUS SEQUENTIAL LOGIC**	**9**
Introduction to Sequential Circuits – Flip-Flops – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design – Moore/Mealy models, state minimization, state assignment, circuit implementation - Registers – Counters		
UNIT – III	**COMPUTER FUNDAMENTALS**	**9**
Functional Units of a Digital Computer: Von Neumann Architecture – Operation and Operands of Computer Hardware Instruction – Instruction Set Architecture (ISA): Memory Location, Address and Operation – Instruction and Instruction Sequencing – Addressing Modes, Encoding ofMachine Instruction – Interaction between Assembly and High Level Language		
UNIT – IV	**PROCESSOR**	**9**
Instruction Execution – Building a Data Path – Designing a Control Unit – Hardwired Control, Microprogrammed Control – Pipelining – Data Hazard – Control Hazards		
UNIT – V	**MEMORY AND I/O**	**9**
Memory Concepts and Hierarchy – Memory Management – Cache Memories: Mapping and Replacement Techniques – Virtual Memory – DMA – I/O – Accessing I/O: Parallel and Serial Interface – Interrupt I/O – Interconnection Standards: USB, SATA		
		Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Design various combinational digital circuits using logic gates
CO2:	Design sequential circuits and analyze the design procedures
CO3:	State the fundamentals of computer systems and analyze the execution of an instruction
CO4:	Analyze different types of control design and identify hazards
CO5:	Identify the characteristics of various memory systems and I/Ocommunication

Textbooks:	
1.	M. Morris Mano, Michael D.Ciletti, "Digital Design: Withan Introduction to the Verilog HDL, VHDL, and System Verilog", Sixth Edition, Pearson Education, 2018
2.	David A.Patterson, John L.Hennessy,"Computer Organization andDesign, The Hardware/Software Interface", Sixth Edition, Morgan Kaufmann/Elsevier, 2020

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Reference books/other materials/webresources:	
1.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky,Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw-Hill, 2012.
2.	William Stallings,"ComputerOrganizationandArchitecture– DesigningforPerformance",TenthEdition,PearsonEducation,2016.
3.	M.MorrisMano,"DigitalLogicandComputerDesign",PearsonEducation,2016.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	3	3	3	3	3	2	1	1	1	1	2	2	3	3
CO2:	3	3	3	3	2	1	1	1	1	1	2	1	2	2
CO3:	3	3	3	3	2	2	1	1	1	1	2	2	3	1
CO4:	3	3	3	3	1	1	1	1	1	1	1	1	3	1
CO5:	3	3	3	3	1	2	1	1	1	1	1	1	2	1
Average:	3	3	3	3	1	2	1	1	1	1	1	1	2	1

Subject Code	Subject Name	Category	L	T	P	C
CS24303	COMPUTER NETWORKS	PCC	3	0	0	3

Course Objectives:

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

UNIT – I	INTRODUCTION AND APPLICATION LAYER	10
Data Communication - Networks – Network Types – Protocol Layering – TCP/IP Protocol suite –OSI Model – Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - IMAP - MIME) – DNS – SNMP		
UNIT – II	**TRANSPORT LAYER**	**9**
Introduction - Transport-Layer Protocols: UDP – TCP: Connection Management – Flow control -Congestion Control - Congestion avoidance (DECbit, RED) – SCTP – Quality of Service		
UNIT – III	**NETWORK LAYER**	**7**

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Switching : Packet Switching - Internet protocol - IPV4 – IP Addressing – Subnetting - IPV6, ARP,RARP, ICMP, DHCP - Routing in MANET.		
UNIT – IV	**ROUTING**	**7**
Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF– Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.		
UNIT – V	**DATA LINK AND PHYSICAL LAYERS**	**12**
Data Link Layer – Framing – Flow control – Error control – Data-Link Layer Protocols – HDLC – PPP- Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) -Physical Layer: Data and Signals - Performance – Transmission media- Switching – Circuit Switching.		
	Total Contact Hours :45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the basic layers and its functions in computer networks
CO2:	Understand the basics of how data flows from one node to another.
CO3:	Analyze routing algorithms
CO4:	Describe protocols for various functions in the network
CO5:	Analyze the working of various application layer protocols

Textbooks:	
1.	James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.
2.	Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, Sixth Edition TMH, 2022

Reference books/other materials/webresources:	
1.	Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition,Morgan Kaufmann Publishers Inc., 2012.
2.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education,2013.
3.	Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2012.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	-	-	3	-	-	-	-	-	2	2	2	
CO2:	3	3	-	-	2	1	-	-	-	-	2	3	2	2

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CO3:	3	3	2	3	2	1	-	-	-	-	2	3	3	2
CO4:	3	2	-	2	2	-	-	-	-	-	2	2	2	2
CO5:	3	2	-	2	2	1	-	-	2	-	-	-	-	-
Average:	3	2.40	2	2.20	2.20	1	-	-	2.20	1	2	2.60	2.40	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24301	**ARTIFICIAL INTELLIGENCE**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To learn the basic AI approaches.
- To develop problem solving agents.
- To explore strategic decision-making through game theory and CSP techniques.
- To Implement logical reasoning and inferences
- To develop solutions using probabilistic approaches to handle uncertainty.

UNIT – I	**INTRODUCTION TO INTELLIGENT SYSTEMS**	**9**
Introduction to AI–Agents and Environments–nature of environments–structure of agents.Problem solving agents–search algorithms–uninformed search strategies		
UNIT – II	**HEURISTIC AND LOCAL SEARCH IN AI**	**9**
Heuristic search strategies – heuristic functions. Local search and optimization problems – local search in continuous space –search with non-deterministic actions– search in partially observable environments – online search agents and unknown environments		
UNIT – III	**GAME PLAYING AND CSP**	**9**
Game theory – optimal decisions in games – alpha-beta search – Monte-carlo tree search – stochastic games – partially observable games. Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP		
UNIT – IV	**LOGICAL REASONING**	**9**
Knowledge-based agents–propositional logic–propositional theorem proving–propositional model checking – agents based on propositional logic. First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution.		
UNIT – V	**PROBABILISTIC REASONING**	**9**
Acting under uncertainty–Bayesian inference–naïve Bayes models-Probabilistic reasoning–Bayesian networks–exact inference in BN–approximate inference in BN–causal networks.		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain intelligent agent frameworks
CO2:	Apply problem solving techniques

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CO3:	Apply game playing and CSP techniques
CO4:	Perform logical reasoning
CO5:	Perform probabilistic reasoning under uncertainty

Textbooks:	
1.	StuartRussellandPeterNorvig,"ArtificialIntelligence–AModernApproach",Fourth Edition,PearsonEducation,2021

Reference books/other materials/webresources:	
1.	DanW. Patterson, "Introduction to AI and ES",PearsonEducation,2007
2.	KevinNight, Elaine Rich ,and NairB., "Artificial Intelligence",McGrawHill,2008
3.	PatrickH. Winston,"Artificial Intelligence",Third Edition ,Pearson Education,2006
4.	DeepakKhemani,"ArtificialIntelligence",Tata McGrawHillEducation,2013. http://nptel.ac.in/

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	2	1	1	1	1	1	2	3	2	2
CO2:	3	3	2	2	3	1	1	2	2	2	3	3	3	2
CO3:	3	3	2	2	3	1	1	2	2	2	3	3	3	3
CO4:	3	2	2	2	3	1	2	2	2	2	3	3	2	2
CO5:	3	2	2	2	3	2	2	2	2	2	3	3	3	3
Average:	2.33	2.67	3	2.33	3	1.2	1.4	1.8	1.8	1.8	2.8	3	2.6	2.4

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24302	**DATA VISUALIZATION**	**PCC**	**2**	**0**	**2**	**3**

Course Objectives:

- To give overview of descriptive and inferential statistics.
- To provide basics of R and Python.
- To manipulate and visualize data using R, python and Watson Studio.
- To focus on plots using Matplotlib and seaborn.
- To analyze data using various visualization tools.
- To create maps in python using folium.

UNIT – I	**INTRODUCTION TO STATISTICS**	**6**
Data collection methods – Descriptive Statistics: Mean, Median, Mode – Inferential Statistics: Random Variables, Probability Distribution		
UNIT – II	**VISUALIZATION USING R**	**6**

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Descriptive data analysis using R – Data manipulation with R (dplyr, data. table, reshape2 package, tidyr package, Lubridate package) - Data Visualization with R (working with ggplot2)		
UNIT – III	**WATSON STUDIO**	**6**
Adding data to data refinery – Preprocessing & Visualization of data in Watson Studio.		
UNIT – IV	**DATA ANALYSIS USING PYTHON**	**6**
Basics of Python , Numpy Library – Arrays creation , Indexing , Slicing , Aggregation , Reshaping, Pandas Library – Series , DataFrame , using csv & excel files , Data cleaning &manipulation ,Merging &Joining.		
UNIT – V	**VISUALIZATION USING PYTHON**	**6**
Data Visualization tools in python – Basic plots using Matplotlib - Advanced Visualization tools using Matplotlib –Sea born functionalities – Spatial visualization and analysis in python in folium		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1. Do the data manipulation operations for iris and mtcars dataset using dplyr package and obtain the results for following functions: i. filter ii. select iii. arrange iv. summarise v. mutate
2. Create a data frame and do the following operations using tidyr package i. gather ii. spread iii. separate iv. unite
3. Do the following operations for any external dataset using data. table package i. Select a subset row ii. Select a column with particular values iii. Select columns with multiple values iv. Select a column to return a vector v. Select multiple columns vi. Returns the sum and standard deviation vii. Sum of selected columns
4. Do the following visualizations for any external csv file i. Line graph ii. Bar graph iii. Histogram iv. Scatter plot v. Pie chart

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5. Do the following Data analysis for your own Data set using pandas package. i. Make the first column as index ii. Select single column and print the data iii. Select multiple columns and print the data iv. Select single column and print the last five elements of the data. v. Select multiple rows and print the first five elements of the data vi. Select multiple rows and columns from the data set and print it. vii. Select all the rows and some columns (more than two) from the data set and print it. viii. Print the same data set again and delete the first column from the data set and print it. ix. Change the 1st, 2nd and 3rd columns name and print it
6. Consider any csv file and do the following visualization using matplot lib package i. Line graph /with style ii. Bar Graph iii. Histogram iv. Scatter plot v. Pie chart
7. Merge the two data sets (any two csv files) and perform the following join i. operations ii. Natural join iii. Full outer join iv. Left outer join v. Right outer join
8.Do the EDA process for loan prediction data set
9.Data analytics and visualization using IBM Watson studio
10.Do the following operations for your own data using pandas i. Descriptive data analytics using pandas ii. Print the data based on particular year, particular month and particular data iii. Filter the data based on conditions (any conditions) iv. Select any two columns and do the pandas sort operations (ascending and descending)
Total Contact Hours : 30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Differentiate descriptive and inferential statistics.
CO2:	Use R to do statistics and to visualize data.
CO3:	Visualize analyzed data using IBM Watson Studio.

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CO4:	Familiar with python scripts used for visualization.
CO5:	Use advance visualization tool and sea born functionalities.

Textbooks:	
1.	IBM -CE Data Visualization Using R, Python and Watson studio

Reference books/other materials/webresources:	
1.	Fundamentals of Data Visualization by Claus O Wilke 2019.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	3	3	-	-	-	-	2	3	3	2	1	1
CO2:	2	2	1	1	1	-	-	-	2	2	3	3	2	2
CO3:	2	1	2	1	-	-	-	-	2	1	1	1	2	1
CO4:	2	1	2	2	-	-	-	-	2	1	2	1	3	3
CO5:	3	2	2	1	1	-	-	-	3	2	1	2	2	1
Average:	2	1	2	2	1	-	-	-	2	2	2	2	2	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24303	**ALGORITHM DESIGN TECHNIQUES**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To illustrate divide and conquer and greedy method design techniques
- To explain graph and dynamic programming for solving various problems
- To apply backtracking and branch and bound technique to solve optimization problems
- To understand the concepts behind NP completeness, approximation algorithms

UNIT – I	**INTRODUCTION**	**9**

Algorithm, pseudo code for expressing algorithms, performance analysis-space complexity, time complexity, asymptotic notation- big (O) notation, omega notation(Ω), theta notation(θ) and little(o) notation, recurrences, disjoint set operations, union and find algorithms.

UNIT – II	**DIVIDE- AND- CONQUER AND GREEDY METHOD**	**10**

DIVIDE AND CONQUER: General method, applications-analysis of binary search, quick sort,merge sort, OR Graphs.GREEDY METHOD: General method, Applications-job sequencing with deadlines, Fractionalknapsack problem, minimum cost spanning trees, Single source shortest path problem, HuffmanTrees.

UNIT – III	**GRAPHS AND DYNAMIC PROGRAMMING:**	**9**

GRAPHS (Algorithm and Analysis): Breadth first search and traversal, Depth first search and traversal, Spanning trees, connected components and bi-connected components, Articulation points. DYNAMIC PROGRAMMING: Applications - optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem.

UNIT – IV	**BACKTRACKING AND BRANCH -AND -BOUND**	**8**

BACKTRACKING: General method, Applications- N-queen problem, Sum of subsets problem,Graph coloring and Hamiltonian cycles. BRANCH AND BOUND: General method,

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applications - travelling sales person problem, 0/1 knapsack problem- LC branch and bound solution, FIFO branch and bound solution.		
UNIT – V	**NP-HARD AND NP-COMPLETE PROBLEMS:**	**9**
Basic concepts, non-deterministic algorithms, NP-hard and NP-complete classes, Cook's theorem. APPROXIMATION ALGORITHMS: Approximation algorithms for NP-Hard Problems–Travelling Salesman Problems-Knapsack Problems.		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand algorithm fundamentals, pseudocode, and performance analysis using asymptotic notations.
CO2:	Apply divide-and-conquer and greedy methods to solve algorithmic problems efficiently.
CO3:	Analyze graph algorithms and dynamic programming techniques for optimization problems.
CO4:	Develop solutions using backtracking and branch-and-bound techniques
CO5:	Evaluate computational complexity and design approximation algorithms for NP-hard problems.

Textbooks:	
1.	Anany Levitin ,Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012

Reference books/other materials/webresources:	
1.	Ellis Horowitz,Sartaj Sahni and Sanguthevar Rajasekaran,ComputerAlgorithms/C++, Second Edition, Universities Press, 2019
2.	Thomas H. Cormen, Charles E .Leiserson, Ronald L .Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
3.	S.Sridhar,DesignandAnalysisofAlgorithms,Oxforduniversitypress,2014
4.	AlfredV. Aho, John E.Hopcroft and Jeffrey D.Ullman, Data Structures and Algorithms, Pearson Education, Reprint 2006

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	2	3	1	0	0	1	0	2	3	2	2
CO2:	3	3	3	2	3	1	0	1	1	1	2	3	3	3
CO3:	3	3	3	2	3	1	0	1	1	1	2	3	3	2
CO4:	3	3	3	3	3	1	0	1	1	2	3	2	3	3
CO5:	3	3	3	3	3	1	1	1	1	2	3	3	3	3
Average:	3	3	2.8	2.4	3.0	1.0	0.2	0.8	1.0	1.2	2.4	2.8	2.8	2.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**

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CS24313	NETWORKS LABORATORY	PCC	0	0	3	1.5

- To understand the concept of layering in networks
- To know the functions of protocols of each layer of the TCP/IP protocol suite.
- To visualize the end-to-end flow of information
- To learn the functions of the network layer and the various routing protocols.
- To familiarize the functions and protocols of the transport layer.

LIST OF EXPERIMENTS

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup, and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine them.
2. Write an HTTP web client program to download a web page using TCP sockets.
3. Develop applications using TCP sockets, such as:
   a)Echo client and echo server
   b)Chat application
4. Simulate a DNS server using UDP sockets.
5. Use a tool like Wireshark to capture packets and analyze them.
6. Write a program simulating ARP/RARP protocols.
7. Study network simulators (NS) and simulate congestion control algorithms using NS.
8. Analyze TCP/UDP performance using a simulation tool.
9. Simulate Distance Vector/Link State routing algorithms.
10. Simulate an error correction code (like CRC)

Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the basic layers and their functions in computer networks.
CO2:	Understand the basics of how data flows from one node to another.
CO3:	Analyze routing algorithms.
CO4:	Describe protocols for various functions in the network.
CO5:	Analyze the working of various application-layer protocols.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**

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CO1:	3	2	2	1	2	1	1	1	1	1	2	3	2	3
CO2:	3	3	2	2	3	1	1	1	1	1	2	3	3	3
CO3:	3	3	2	2	3	2	1	1	2	1	2	3	3	3
CO4:	3	3	3	2	3	2	1	1	2	2	2	3	3	3
CO5:	3	3	2	2	3	2	1	1	2	2	2	3	3	3
Average:	3	2.8	2.2	1.8	2.8	1.6	1	1	1.6	1.4	2	3	2.8	3

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24311	**ARTIFICIAL INTELLIGENCE LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

- To design and implement search strategies
- To implement game playing techniques
- To implement CSP techniques
- To develop systems with logical reasoning
- To develop systems with probabilistic reasoning

LIST OF EXPERIMENTS

1.Implementation of a Model-Based Agent

2.Implementation of Greedy Best-First Search Algorithm

3.Implementation of Hill Climbing Algorithm for Local Search

4.Implementation of Memory Bounded A* Algorithm

5. Implementation of Alpha Beta Tree search.

6.Solving 8-Queens Problem using Backtracking

7.Implementation of Tic-Tac-Toe AI using Mini-max Algorithm

8.Implementation of Forward and Backward Chaining in AI

9.Implementation of First-Order Logic (FOL) Inference System

10.Implementation of Probabilistic Reasoning using Bayesian Networks

Total Contact Hours : 45

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Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand and build a agent to solve simple problems
CO2:	Design and implement search strategies
CO3:	Implement game-playing strategies and constraint satisfaction techniques for AI-based decision-making.
CO4:	Develop and apply logical reasoning methods for knowledge inference in AI systems.
CO5:	Implement probabilistic reasoning techniques to handle uncertainty in AI applications.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	2	3	2	1	1	1	1	2	3	2	3
CO2:	3	2	2	2	3	2	1	1	1	1	2	3	3	3
CO3:	3	3	2	2	3	2	1	1	1	1	2	3	3	3
CO4:	3	3	2	3	3	2	2	1	1	1	2	3	3	3
CO5:	3	3	2	3	3	2	2	1	1	1	2	3	3	3
Average:	3	2.6	2	2.4	3	2	1.4	1	1	1	2	3	2.8	3

SEMESTER-IV

Subject Code:	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
MA24401	**PROBABILITY AND STATISTICS**	**BSC**	**3**	**1**	**0**	**4**

Course objectives:

- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of Special distribution.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of non parametric test.
- To introduce the basic concepts of classifications of design of experiments. Which plays very important roles in the field of agriculture and statistical quality control.

UNIT – I	**PROBABILITY AND RANDOM VARIABLES**	**9+3**
Axioms of porbability - Conditional Probability - Baye's Theorem – One dimensional Discreate and Continous Random variables - Moments – Moment generating functions		
UNIT – II	**SPECIAL DISTRIBUTIONS**	**9+3**
Discrete distributions : Binomial, Poisson, Geometric – Continuous distributions: Uniform, Exponential and Normal distribution.		
UNIT – III	**TWO DIMENSIONAL RANDOM VARIABLES**	**9+3**

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Two dimensional random variables: Joint distribution - Marginal and Conditional distributions -Covariance – Correlation co-efficients – Regression lines.		
UNIT – IV	**NON PARAMETRIC TESTS**	**9+3**
Introduction - The sign test - The Signal - Rank test - Rank sum tests - The U-test - The H-test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.		
UNIT – V	**STATISTICAL QUALITY CONTROL**	**9+3**
Control charts for measurements(X and R charts) - Control charts for attributes (p,c,np charts) - Tolreance Limits - Acceptance Sampling.		
		Total Contact Hours : 60

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the basic concepts of Probabilitys and Random variables and apply in Engineering applications.
CO2:	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO3:	Apply the concept of Two dimensional random variable in Engineering Disciplines
CO4:	Use the concept of non parametric testing for Non-Normal population.
CO5:	Apply the basic concepts of classifications of design of experiments in the field of agricalture and statistical quality control

Textbooks:	
1.	Johnson. R.A., Miller. I.RandFreund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia,9th Edition, 2016.
2.	Milton. J. S. and Arnold.J.C., "Introduction to Probability and Statistics", Tata Mc GrawHill, 4th Edition, 2007.
3	John E.Freund,"MathematicalStatistics", Prentice Hall,5th Edition, 1992.

Reference books/other materials/web resources:	
1.	Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences",Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
4.	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012.
5.	Walpole.R.E.,Myers.R.H.,Myers.S.L.and Ye.K.,"Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th Edition, 2010.

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	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO2:	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO3:	3	3	-	-	-	-	-	-	2	-	2	-	-	-
CO4:	3	3	3	2	-	-	-	-	2	-	2	-	-	-
CO5:	3	3	2	2	-	-	-	-	2	-	2	-	-	-
Average:	3	3	2.5	2	-	-	-	-	2	-	2	-	-	-

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24401	**FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To understand the techniques and processes of data science
- To apply descriptive data analytics
- To visualize data for various applications
- To understand inferential data analytics
- To analysis and build predictive models from data

UNIT – I	**INTRODUCTION TO DATA SCIENCE**	**8**

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT – II	**DESCRIPTIVE ANALYTICS**	**10**

Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

UNIT – III	**INFERENTIAL STATISTICS**	**9**

Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size

UNIT – IV	**ANALYSIS OF VARIANCE**	**9**

t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related

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samples. F-test – ANOVA – Two factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.		
UNIT – V	**PREDICTIVE ANALYTICS**	**9**
Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.		
		Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the data analytics pipeline
CO2:	Describe and visualize data
CO3:	Perform statistical inferences from data
CO4:	Analyze the variance in the data evaluation measures, and
CO5:	Build models for predictive analytics

Textbooks:	
1.	David Cielen, ArnoD. B.Meysman,and Mohamed Ali, "Introducing Data Science", Manning Publications,2016.(first two chapters for UnitI).
2.	RobertS.Witte and JohnS.Witte,"Statistics",Eleventh Edition,Wiley Publications,2017.
3.	JakeVander Plas,"Python Data Science Handbook",O'Reilly,2016

Reference books/other materials/webresources:	
1.	Allen B.Downey, "ThinkStats: Exploratory Data Analysis in Python", Green Tea Press, 2014
2.	SanjeevJ.Wagh,ManishaS.Bhende,AnuradhaD.Thakare,"Fundamentals of Data Science", CRC Press, 2022
3.	ChiragShah,"A Hands-On Introduction to DataScience",Cambridge UniversityPress,2020.
4.	Vineet Raina,Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice",Apress,2021

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	1	1	2	1	-	-	-	-	3	1	3	3	3	1
CO2:	1	1	2	2	2	-	-	-	2	2	3	3	1	1
CO3:	1	1	3	1	1	-	-	-	2	3	1	2	3	1
CO4:	2	3	1	3	1	-	-	-	3	3	3	3	2	2
CO5:	2	1	1	1	2	-	-	-	3	3	1	2	2	1
Average:	1	1	2	2	2	-	-	-	3	2	2	3	2	1

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Subject Code	Subject Name	Category	L	T	P	C
AD24402	FUNDAMENTALS OF OPERATING SYSTEMS	PCC	3	0	0	3

Course Objectives:

- To understand the basics and functions of operating systems
- To understand the processes and analyze the CPU scheduling algorithms
- To understand the concepts of deadlock and process synchronization
- To be familiar with I/O management and File systems.
- To be familiar with the basics of virtual machines and analyze various memory management schemes.

UNIT – I	**Operating System**	**9**
Operating System-Introduction, Operating system services Structures-Simple Batch, Multi-programmed, Time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, and Operating System services-System Call.		
UNIT – II	**Process and CPU Scheduling**	**9**
Processes – Process Concept – Process Scheduling – Operations on Processes – Inter-process Communication- Threads-Scheduling Criteria-Scheduling Algorithms-Multiple – Processor Scheduling.		
UNIT – III	**Deadlocks and process synchronization**	**9**
Deadlocks - System Model- Deadlocks Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery from Deadlock. The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors.		
UNIT – IV	**Disk Management and file system operations.**	**9**
Disk Scheduling Algorithms-FCFS,SSTF, SCAN,C-SCAN File System Interface and Operations -Access methods, Directory Structure, Protection, File System Structure, Allocation methods, kernel support for files.		
UNIT – V	**Memory Management and Virtual Machines**	**9**
Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Demand Paging, Page Replacement, Page Replacement Algorithms-Types of virtual machines and their implementations		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the fundamental concepts of operating systems
CO2:	Analyze the various CPU scheduling algorithms
CO3:	Explain deadlock prevention,avoidance algorithms and process synchronization
CO4:	Explain the functionality of file systems I/O systems
CO5:	Compare and contrast various memory management schemes

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Textbooks:	
1.	Abraham Silberschatz ,Peter Baer Galvin and Greg Gagne, "OperatingSystemConcepts",9th Edition,John Wiley and Sons Inc.,2018
2.	AndrewSTanenbaum,"ModernOperatingSystems",Pearson,4thEdition,NewDelhi,2016

Reference books/other materials/webresources:	
1.	Ramaz Elmasri ,A. GilCarrick, David Levine, "Operating Systems–A Spiral Approach",Tata McGrawHill Edition,2010
2.	William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018
3.	AchyutS. Godbole,Atul Kahate,"Operating Systems",McGrawHillEducation,2016

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	3	1	1	1	-	-	-	-	1	1	1	2	1	2
CO2:	2	3	1	3	1	-	-	-	3	2	2	3	3	1
CO3:	2	2	3	3	2	-	-	-	3	1	1	1	1	1
CO4:	2	2	1	2	1	-	-	-	1	3	2	1	1	2
CO5:	2	3	3	2	1	-	-	-	3	1	2	3	1	2
Average:	2	2	2	2	1	-	-	-	2	2	2	2	1	2

Subject Code	Subject Name	Category	L	T	P	C
AD24403	DATABASE DESIGN AND MANAGEMENT	PCC	3	0	0	3

Course Objectives:

- To introduce database development lifecycle and conceptual modeling
- To learn SQL for data definition ,manipulation and querying a database
- To learn relational database design using conceptual mapping and normalization
- To learn transaction concepts and serializability of schedules
- To learn data model and querying in object-relational and No-SQL databases

UNIT – I	CONCEPTUAL DATA MODELING	8
Database environment–Database system development life cycle–Requirements collection–Database design--Entity-Relationship model–Enhanced-ER model–UML class diagrams		
UNIT – II	**RELATIONAL MODEL AND SQL**	**10**
Relational model concepts—Integrity constraints : Domain, Key, Referential, Check, Implementation of Constraints in SQL—SQL Data manipulation : Inserting, Modifying, Deleting, Querying, Joins–SQL Data definition : Creating and Managing Databases, Defining Tables and Data Types, Implementing Constraints, Indexing for Performance Optimization–Views—SQL programming.		
UNIT – III	**RELATIONAL DATABASE DESIGN AND NORMALIZATION**	**10**
ER and EER-to-Relational mapping – Update anomalies – Functional dependencies – Inference rules – Minimal cover – Properties of relational decomposition – Normalization		

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(upto BCNF).		
UNIT – IV	**TRANSACTION MANAGEMENT**	**8**
Transaction concepts–properties–Schedules–Serializability–ConcurrencyControl–Two-phase locking techniques. Programmatic SQL: Embedded SQL, Dynamic SQL, Advanced SQL-Programming in MYSQL.		
UNIT – V	**OBJECT RELATIONAL AND NO-SQL DATABASES**	**9**
Mapping EER toODBschema –Object identifier – referencetypes –rowtypes – UDTs – Subtypes andsupertypes–user-definedroutines–Collectiontypes–ObjectQueryLanguage;No-SQL:CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the database development life cycle and apply conceptual modeling
CO2:	Apply SQL and programming in SQL to create, manipulate and query the database
CO3:	Apply the conceptual-to relational mapping and normalization to design relational database
CO4:	Determine the serializability of any non-serial schedule using concurrency techniques
CO5:	Apply the data model and querying in Object-relational and No-SQL databases.

Textbooks:	
1.	Thomas M. Connolly,Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation, and Management, Sixth Edition, Global Edition, Pearson Education, 2015.
2.	Ramez Elmasri,Shamkant B.Navathe,Fundamentals of DatabaseSystems,7th Edition, Pearson, 2017.

Reference books/other materials/webresources:	
1.	Toby Teorey, Sam Light stone, Tom Nadeau, H.V.Jagadish, "DATABASEMODELING AND DESIGN-Logical Design",Fifth Edition,Morgan Kaufmann Publishers,2011
2.	Carlos Coronel, Steven Morris and Peter Rob,Database Systems:Design, Implementation, and Management, Ninth Edition, Cengage learning, 2012
3.	Abraham Silberschatz,Henry F Korth,SSudharshan, "Database System Concepts",6th Edition, Tata Mc GrawHill, 2011.

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4.	Hector Garcia- Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems :The Complete Book", 2nd edition, Pearson.
5.	Raghu Ramakrishnan,"Database Management Systems",4thEdition,TataMcGrawHill,2010.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	1	2	-	-	-	-	-	2	3	2	3
CO2:	3	3	2	2	3	-	-	-	-	-	2	3	3	3
CO3:	3	3	3	2	3	-	-	-	-	-	2	3	2	3
CO4:	3	3	2	3	3	-	-	-	-	-	2	3	3	3
CO5:	3	2	2	2	3	-	-	-	-	-	3	3	3	3
Average:	3	2.60	2.20	2.20	2.80						2.20	3	2.60	3

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
GE24901	**ENVIRONMENTAL SCIENCES AND SUSTAINABILITY**	**BSC**	**2**	**0**	**0**	**2**

Course Objectives:

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

UNIT – I	**ENVIRONMENT AND BIODIVERSITY**	**6**

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT – II	**ENVIRONMENTAL POLLUTION**	**6**

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT – III	**NATURAL RESOURCES**	**6**

Forest resources: Use and over-exploitation, deforestation, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. New Renewable

Energy Sources: Hydrogen energy, Solar energy, wind energy, Tidal energy, Ocean thermal energy and Geothermal energy. Role of an individual in conservation of natural resources.		
UNIT – IV	**SUSTAINABILITY PRACTICES**	**6**
Zero waste and R concept, Circular economy, Material Life cycle assessment, Environmental Impact Assessment, ISO 14000 Series, Green buildings. Water conservation, rain water harvesting. Issues and possible solutions – climate change, global warming. Concept of Carbon Credit and Carbon Footprint. Development and GDP.Environmental management in industry-A, case study.		
UNIT – V	**SOCIAL ISSUES AND POPULATION**	**6**
Population growth, variation among nations – population explosion – family welfare programme –environment and human health–human rights–value education–HIV/AIDS– women and child welfare – role of information technology in environment and human health – Case studies. Urban problems related to energy.		
		Total Contact Hours : 30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
CO2:	To identify causes effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
CO3:	To apply knowledge on the conservation of natural resources by keeping the sustainable development as a main goal.
CO4:	To identify the importance of Development as a standard of living otherwise that leads to serious environmental disasters.
CO5:	To demonstrate the knowledge about human population and its drastic change which will eventually lead to unsustainable development.

Textbooks:	
1.	AnubhaKaushikandC.P.Kaushik's"PerspectivesinEnvironmentalStudies",6thEdition, New Age International Publishers ,2018.
2.	Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, NewDelhi, 2016.
3.	GilbertM.Masters,'Introduction toEnvironmentalEngineeringandScience',2nd edition, Pearson Education, 2004.
4.	Allen, D.T.and Shonnard, D.R.,SustainabilityEngineering: Concepts, Designand Case Studies, Prentice Hall.
5.	Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
6.	Mackenthun,K.M.,Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

Reference books/other materials/webresources:

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1.	R.K.Trivedi,'Handbook of Environmental Laws,Rules,Guidelines,Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2.	Cunningham, W.P.Cooper, T.H.Gorhani,'Environmental Encyclopedia',JaicoPubl., House, Mumbai, 2001.
3.	DharmendraS.Sengar, 'Environmental law', Prentice hall of India PVT.LTD, New Delhi, 2007.
4.	Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5.	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	-	-	-	-	-	2	3	-	-	2	-	-	-	-
CO2:	2	-	-	-	-	2	3	-	-	2	-	-	-	-
CO3:	2	-	-	-	-	2	3	-	-	2	-	-	-	-
CO4:	-	-	-	-	-	2	3	-	-	2	-	-	-	-
CO5:	-	-	-	-	-	-	3	-	-	2	-	-	-	-
Average:	2	1	-	-	-	2	3	-	-	2	-	-	-	-

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AM24404	**MACHINE LEARNING**	**PCC**	**2**	**0**	**2**	**3**

Course Objectives:

- Understand the necessity of machine learning for addressing diverse problem-solving scenarios.
- Study various machine learning algorithms, including supervised, semi-supervised, and unsupervised learning techniques
- Explore emerging approaches and advancements in machine learning.
- Leverage Watson Studio for a collaborative environment equipped with tools to address business challenges effectively
- Utilize tools in Watson Studio to analyze and visualize data, cleanse and prepare data, ingest streaming data, and develop and train machine learning models

UNIT – I	**INTRODUCTION TO MACHINE LEARNING**	**6**
Machine learning Introduction-Types of Machine learning -Supervised, Unsupervised, and reinforcement-Over fitting and Regression-Classification-Clustering-Examples		
UNIT – II	**INTRODUCTION TO IBM CLOUD**	**6**
Introduction to IBM Cloud- Resources-IBM Cloud Infrastructure- Security-IBM Cloud Foundry-Cloud Park for data- IBM Cloud vs Amazon Cloud - Cloud Native Storage and Data Service		
UNIT – III	**INTRODUCTION TO WASTON STUDIO**	**6**

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Introduction to Watson Studio- Project creation- Storage- Access control-Prebuilt Watson application- Watson Solutions- Catalog and govern data		
UNIT – IV	**MACHINE LEARNING IN WATSON**	**6**
Watson Knowledge Studio and Watson Knowledge catalog-Watson Discovery Services-Watson Auto AI-Watson Open Scale- Watson API		
UNIT – V	**NATURAL LANGUAGE PROCESSING**	**6**
NLP Introduction-Natural Language Understanding (NLU)-Conversational AI-Building blocks of chat bot-Watson Assistant-Speech to Text -Text to speech.		
	Total Contact Hours : 30	

LIST OF EXPERIMENTS
1. Implement a Linear Regression model to predict house prices using a dataset.
2.Train a K-Nearest Neighbors (KNN) classifier on the Iris dataset and evaluate its accuracy
3.Perform sentiment analysis on a given text using IBM Watson Natural Language Understanding (NLU).
4. Deploy a Flask web application on IBM Cloud Foundry.
5. Apply K-Means clustering to segment customers based on their purchasing behavior.
6. Convert an audio file to text using IBM Watson Speech-to-Text API.
7.Build a basic Chabot using IBM Watson Assistant and integrate it into a Python application
8. Train a Convolutional Neural Network (CNN) to classify images from the MNIST dataset.
9. Implement Logistic Regression for spam email detection using a text dataset.
10. Use IBM Watson Natural Language Understanding (NLU) to extract named entities from a giv text.
Total Contact Hours : 30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Analyze various methods and theories in the filed of ML
CO2:	Gain an understanding of the fundamental principles and techniques of ML
CO3:	Utilize Watson Studio to streamline the process from experimentation to deployment, enhance data exploration and accelerate model development and training
CO4:	Demonstrate the creation and application of AI models.
CO5:	Analyse and evaluate the performance of the AI models

Textbooks:	
1.	IBM Courseware

Reference books/other materials/webresources:	
1.	Ethem Alpaydin,“Introduction to MachineLearning”,MITPress,FourthEdition,2020

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2.	StephenMarsland,"MachineLearning:AnAlgorithmicPerspective,"SecondEdition",CRCPress, 2014.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	1	2	1	-	-	-	-	3	3	2	2	2	1
CO2:	1	3	3	1	2	-	-	-	2	2	2	3	1	1
CO3:	2	1	3	3	2	-	-	-	1	1	1	1	2	1
CO4:	2	3	3	2	1	-	-	-	3	2	3	1	2	1
CO5:	1	1	3	3	1	-	-	-	3	1	1	3	3	2
Average:	2	2	3	2	2	-	-	-	2	2	2	2	2	1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24413	**DATABASE DESIGN AND MANAGEMENT LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

- To understand the database development life cycle
- To learn database design using conceptual modeling, Normalization
- To implement database using Data definition, Querying using SQL manipulation and SQL programming
- To implement database applications using IDE/RAD tools
- To learn querying Object-relational databases

LIST OF EXPERIMENTS

1. Database Development Life cycle: Problem definition and Requirement analysis Scope and Constraints
2. Database design using Conceptual modeling (ER-EER) – top-down approach Mapping conceptual to relational database and validate using Normalization
3. Implement the database using SQL Data definition with constraints, Views
4. Query the database using SQL Manipulation
5. Querying/Managing the database using SQL Programming - Stored Procedures/Functions – Constraints and security using Triggers
6. Database design using Normalization – bottom-up approach
7. Develop database applications using IDE/RAD tools (Eg., NetBeans,VisualStudio)
8. Database design using EER-to-ODB mapping / UML class diagrams
9. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
10. Querying the Object-relational database using Objet Query language

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	Total Contact Hours:45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the database development life cycle
CO2:	Design relational database using conceptual-to-relational mapping, Normalization
CO3:	Apply SQL for creation, manipulation and retrieval of data
CO4:	Develop a database applications for real-time problems
CO5:	Design and query object-relational databases

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	2	1	–	1	1	1	2	3	2	2
CO2:	3	3	3	2	3	1	–	1	1	1	2	3	3	3
CO3:	3	3	2	2	3	1	–	1	1	1	2	3	3	3
CO4:	3	3	3	2	3	1	–	1	2	2	2	3	3	3
CO5:	3	3	3	2	3	1	–	1	2	2	2	3	3	3
Average:	3	2.8	2.4	1.8	2.8	1	–	1	1	1.4	2	3	2.8	2.8

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CS24413	**DATA SCIENCE LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

- To understand the python libraries for data science
- To understand the basic Statistical and Probability measures for data science.
- To learn descriptive analytics on the benchmark data sets.
- To apply correlation and regression analytics on standard data sets.
- To present and interpret data using visualization packages in Python.

LIST OF EXPERIMENTS

1. Download, install and explore the features of NumPy, SciPy, Jupyter, Statsmodels and Pandas packages.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Reading data from text files, Excel and the web and exploring various commands for doing descriptive analytics on the Iris data set.

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5. Use the diabetes data set from UCI and Pima Indians Diabetes 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 modeling c. Multiple Regression analysis d. Also compare the results of the above analysis for the two data sets.
6. Apply and explore various plotting functions on UCI data sets. a. Normal curves b. Density and contour plots c. Correlation and scatter plots d. Histograms e. Three dimensional plotting
7. Visualizing Geographic Data with Basemap
Total Contact Hours :45

Course Outcomes:	At the end of this course, the students will be able to:
CO1:	Make use of the python libraries for data science
CO2:	Make use of the basic Statistical and Probability measures for data science.
CO3:	Perform descriptive analytics on the benchmark data sets
CO4:	Perform correlation and regression analytics on standard data sets
CO5:	Present and interpret data using visualization packages in Python.

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	-	-	-	-	1	3	3	1	3	2
CO2:	3	2	2	3	1	-	-	-	3	1	3	1	3	3
CO3:	3	2	1	3	1	-	-	-	2	1	1	3	2	3
CO4:	2	3	1	3	-	-	-	-	2	3	2	3	3	1
CO5:	1	2	3	1	1	-	-	-	2	1	3	1	3	3
Average:	2	2	2	2	1	-	-	-	2	2	2	2	3	2

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Subject Code	Subject Name	Category	L	T	P	C
AD24501	DEEP LEARNING	PCC	3	0	0	3

Course Objectives:

- To understand and need and principles of deep neural networks
- To understand CNN and RNN architectures of deep neural networks
- To comprehend advanced deep learning models
- To learn the evaluation metrics for deep learning models

UNIT – I	DEEP NETWORKS BASICS	9

Linear Algebra: Scalars - Vectors - Matrices and tensors; Probability Distributions - Gradient-based Optimization – Machine Learning Basics: Capacity - Overfitting and underfitting - Hyperparameters and validation sets - Estimators - Bias and variance - Stochastic gradient descent - Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization - Optimization.

UNIT – II	CONVOLUTIONAL NEURAL NETWORKS	9

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

UNIT – III	RECURRENT NEURAL NETWORKS	10

Unfolding Graphs - RNN Design Patterns: Acceptor - Encoder -Transducer; Gradient Computation - Sequence Modeling Conditioned on Contexts - Bidirectional RNN - Sequence

to Sequence RNN – Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units: Skip connections and dropouts; Gated Architecture: LSTM.		
UNIT – IV	**MODEL EVALUATION**	**8**
Performance metrics - Baseline Models - Hyperparameters: Manual Hyperparameter - Automatic Hyperparameter - Grid search - Random search - Debugging strategies.		
UNIT – V		**9**
Autoencoders: Undercomplete autoencoders - Regularized autoencoders - Stochastic encoders and decoders - Learning with autoencoders; Deep Generative Models: Variational autoencoders – Generative adversarial networks.		
		Total Contact Hours : 45

Course Outcomes:	After the completion of this course, students will be able to:
CO1:	Explain the basics in deep neural networks
CO2:	Apply Convolution Neural Network for image processing
CO3:	Apply Recurrent Neural Network and its variants for text analysis
CO4:	Apply model evaluation for various applications
CO5:	Apply autoencoders and generative models for suitable applications

Textbooks:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning", MIT Press, 2016.
2.	Andrew Glassner, “Deep Learning: A Visual Approach”, No Starch Press, 2021.

Reference books/other materials/webresources:	
1.	Salman Khan, Hossein Rahmani, Syed Afaq Ali Shah, Mohammed Bennamoun, ``A Guide to Convolutional Neural Networks for Computer Vision", Synthesis Lectures on Computer Vision, Morgan & Claypool publishers, 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.	Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 2018.
5.	Josh Patterson, Adam Gibson, ``Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	3	1	-	-	2	3	1	2	3	3	3

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CO2:	2	2	2	3	3	-	-	1	2	2	3	1	1	3
CO3:	3	3	3	3	3	-	-	2	1	1	2	2	1	3
CO4:	3	3	1	1	1	-	-	1	3	1	3	2	1	1
CO5:	3	2	2	2	3	-	-	2	3	2	2	2	3	3
Average:	2.8	2.4	2	2.4	2.2	-	-	1.6	2.4	1.4	2.4	2	1.8	2.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24502	**DATA ANALYTICS**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To understand big data.
- To learn and use No SQL big data management.
- To learn map reduce analytics using Hadoop and related tools.
- To work with map reduce applications.
- To understand the usage of Hadoop related tools for Big Data Analytics .

UNIT – I	**UNDERSTANDING BIG DATA**	**9**
Evolution of Big Data, Types of Digital Data. Classification of Digital Data, Structured Data. Semi- Structured Data. Unstructured Data, Definition of Big Data, web analytics – big data applications– mobile business intelligence – Crowd sourcing analytics – inter and trans firewall analytics.		
UNIT – II	**The Big Data Technology Landscape & Algorithms**	**9**
CAP Theorem – BASE. Concept, NoSQL, Types of No SQL databases, Introduction to MongoDB, Data Types in MongoDB. Applying Linear Regression, Clustering, Association rule mining. Decision tree on Big Data - Introduction to IBM InfoSphereBigInsights		
UNIT – III	**BASICS OF HADOOP**	**9**
HDFS(Hadoop Distributed File System) The Design of HDFS, HDFS Concepts, Command Line Interface,Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures – CASSANDRA		
UNIT – IV	**MAP REDUCE APPLICATIONS**	**8**
Routing and protocols: Unicast routing - Distance Vector Routing - RIP - Link State Routing – OSPF– Path-vector routing - BGP - Multicast Routing: DVMRP – PIM.		
UNIT – V	**HADOOP RELATED TOOLS**	**10**
Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS**..**		
	Total Contact Hours :45	

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Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Describe big data and use cases from selected business domains.
CO2:	Explain NoSQL big data management.
CO3:	Install, configure, and run Hadoop, HDFS and Cassandra.
CO4:	Perform map-reduce analytics using Hadoop.
CO5:	Use Hadoop-related tools such as HBase, Pig, and Hive for big data analytics.

Textbooks:	
1.	Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2.	Eric Sammer, "Hadoop Operations", O'Reilley, 2012
3.	Sadalage, Pramod J. "NoSQL distilled", 2013

Reference books/other materials/webresources:	
1.	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012
2.	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3.	Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010. 112
4.	Alan Gates, "Programming Pig", O'Reilley, 2011

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	3	2	-	-	3	-	-	-	-	-	2	2	2	
CO2:	1	3	-	-	2	1	-	-	-	-	2	3	2	2
CO3:	3	2	2	3	2	1	-	-	-	-	2	3	3	2
CO4:	3	3	-	2	2	-	-	-	-	-	2	2	2	2
CO5:	3	3	-	2	2	1	-	-	2	-	-	-	-	-
Average:	2.6	2.6	2	2.20	2.20	1	-	-	2.20	1	2	2.60	2.40	2

Subject Code	Subject Name	Category	L	T	P	C
CS24503	EMBEDDED SYSTEMS AND IOT	ESC	3	0	0	3

Course Objectives:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing I/O devices to the processor.
- To introduce the evolution of the Internet of Things (IoT).
- To build a small low-cost embedded and IoT system using Arduino/Raspberry Pi/ open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT – I	8-BIT EMBEDDED PROCESSOR	9

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8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt Handling.		
UNIT – II	**EMBEDDED C PROGRAMMING**	**9**
Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Multiple Tasks and Processes – Context Switching – Priority Based Scheduling Policies.		
UNIT – III	**IOT AND ARDUINO PROGRAMMING**	**9**
Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.		
UNIT – IV	**IOT COMMUNICATION AND OPEN PLATFORMS**	**9**
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.		
UNIT – V	**APPLICATIONS DEVELOPMENT**	**9**
Complete Design of Embedded Systems – Development of IoT Applications – Home Automation – Smart Agriculture – Smart Cities – Smart Healthcare–Smart Manufacturing– Supply chain management.		
		Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the architecture of embedded processors.
CO2:	Write embedded C programs.
CO3:	Design simple embedded applications.
CO4:	Compare the communication models in IOT.
CO5:	Design IoT applications using Arduino/Raspberry Pi /open platform

Textbooks:	
1.	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014
2.	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.

Reference Books/Other Materials/WebResources:	
1.	Michael J. Pont, "Embedded C", Pearson Education, 2007.

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2.	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
3.	Andrew N Sloss, D. Symes, C. Wright, "Arm System Developer's Guide", Morgan Kauffman/ Elsevier, 2006.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	-	-	-	1	2	3	3	2	1	3
CO2:	2	1	3	2	2	-	-	1	2	2	3	3	1	3
CO3:	3	1	3	3	1	-	-	1	2	1	1	1	3	3
CO4:	3	2	3	2	1	-	-	1	2	2	2	2	2	1
CO5:	2	3	3	2	2	-	-	1	3	3	3	3	1	3
Average:	2.6	2	3	2.4	1.5	-	-	1	2.2	2.2	2.4	2.4	1.6	2.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24511	**DEEP LEARNING LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand the tools and techniques to implement deep neural networks
- To apply different deep learning architectures for solving problems
- To implement generative models for suitable applications
- To learn to build and validate different models

LIST OF EXPERIMENTS

1.Solving XOR problem using DNN

2. Character recognition using CNN

3. Face recognition using CNN

4. Language modeling using RNN

5. Sentiment analysis using LSTM

6. Parts of speech tagging using Sequence to Sequence architecture

7. Machine Translation using Encoder-Decoder model

8. Image augmentation using GANs

9. Mini-project on real world applications

Total Contact Hours :45

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Course Outcomes:	After the completion of this course, students will be able to:
CO1:	Apply deep neural network for simple problems.
CO2:	Apply Convolution Neural Network for image processing .
CO3:	Apply Recurrent Neural Network and its variants for text analysis .
CO4:	Apply generative models for data augmentation .
CO5:	Develop real-world solutions using suitable deep neural networks.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24512	**DATA ANALYTICS LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

- To understand the installation and configuration of Hadoop and related tools
- To gain hands-on experience in managing files and directories in Hadoop.
- To implement and execute basic MapReduce programs using Hadoop.
- To learn how to perform data operations using Hive and HBase.
- To practice importing and exporting data between databases using Hadoop and related tools.

LIST OF EXPERIMENTS

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1. Web Analytics using Python and R	
2. Tracking COVID-19 Trends using PYTHON	
3. Real-Time Stock Market Analysis using MongoDB	
4. Library Book Borrowing Pattern Analysis using Association Rules	
5. Introduction to Cassandra: Keyspace and Table Creation	
6. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.	
7. Implementing YARN for Resource Management in Hadoop	
8. HiveQL: Creating Tables and Running Queries in Hive	
9. Integrating HBase with Hive: Querying HBase Tables from Hive	
	Total Contact Hours : 45

Software Requirements: Hadoop, R, MongoDB, Cassandra, YARN, Pig, Hive and HBase.

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the Hadoop ecosystem, its components, and modes of operation.
CO2:	Perform basic file management tasks within Hadoop.
CO3:	Implement and execute a basic MapReduce program to solve real-world problems.
CO4:	Install and use Hive and HBase for data storage and querying.
CO5:	Import and export data between various databases using Hadoop technologies.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

SEMESTER VI

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AM24601	**NATURAL LANGUAGE PROCESSING**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To learn the fundamentals of natural language processing..
- To learn the word level analysis methods .
- To explore the syntactic analysis concepts.
- To understand the semantics and pragmatics.

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- To learn to analyze discourses and Lexical Resources.

UNIT – I	**INTRODUCTION**	**9**
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**	**9**
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**	**9**
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, DynamicProgramming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK,Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.		
UNIT – IV	**SEMANTICS AND PRAGMATICS**	**9**
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**	**9**
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 Contact Hours : 45

Course Outcomes:	At the end of this course, the students will be able to:
CO1:	Tag a given text with basic Language features
CO2:	Implement a rule based system to tackle morphology/syntax of a language
CO3:	Design a tag set to be used for statistical processing for real-time applications.
CO4:	Compare and contrast the use of different statistical approaches for different types of NLP applications.
CO5:	Use tools to process natural language and design innovative NLP applications.

Textbooks:	
1.	Daniel Jurafsky, James H. Martin―Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2.	Steven Bird, Ewan Klein and Edward Loper, ―Natural Language Processing with Python, First Edition, O'Reilly Media, 2009.

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Reference Books/Other Materials/WebResources:	
1.	Breck Baldwin, ―Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2.	Richard M Reese, ―Natural Language Processing with Java‖, O'Reilly Media, 2015.
3.	Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4.	Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	3	3	2	3	3	1	-	-	-	1	3	3	-
CO2:	2	3	3	2	3	3	1	-	-	-	1	3	3	-
CO3:	2	3	3	2	3	3	1	-	-	-	1	3	3	-
CO4:	2	3	3	2	3	3	1	-	-	-	1	3	3	-
CO5:	2	3	3	2	3	3	1	-	-	-	1	3	3	-
Average:	2	3	3	2	3	3	1	-	-	-	1	3	3	-

Subject Code	Subject Name	Category	L	T	P	C
AD24601	**DISTRIBUTED COMPUTING**	**PCC**	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the computation and communication models of distributed systems.
- To illustrate the issues of synchronization and collection of information in distributed systems.
- To describe distributed mutual exclusion and distributed deadlock detection techniques.
- To elucidate agreement protocols and fault tolerance mechanisms in distributed systems.
- To explain the cloud computing models and the underlying concepts.

UNIT – I	**INTRODUCTION**	**8**
Introduction: Definition-Relation to Computer System Components – Motivation – Message - Passing Systems versus Shared Memory Systems – Primitives for Distributed Communication – Synchronous versus Asynchronous Executions – Design Issues and Challenges; A Model of Distributed Computations: A Distributed Program – A Model of Distributed Executions – Models of Communication Networks – Global State of a Distributed System.		

UNIT – II	**LOGICAL TIME AND GLOBAL STATE**	**10**
Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time; Message Ordering and Group Communication: Message Ordering Paradigms – Asynchronous Execution with Synchronous Communication – Synchronous Program Order on Asynchronous System – Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.		

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UNIT – III	DISTRIBUTED MUTEX AND DEADLOCK	10
Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart- Agrawala's Algorithm — Token-Based Algorithms – Suzuki-Kasami's Broadcast Algorithm; Deadlock Detection in Distributed Systems: Introduction – System Model – Preliminaries – Models of Deadlocks – Chandy-Misra-Haas Algorithm for the AND model and OR Model.		
UNIT – IV	**CONSENSUS AND RECOVERY**	**10**
Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure-Free System(Synchronous and Asynchronous) – Agreement in Synchronous Systems with Failures; Checkpointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Checkpoint-based Recovery – Coordinated Checkpointing Algorithm -- Algorithm for Asynchronous Checkpointing and Rec		
UNIT – V	**CLOUD COMPUTING**	**7**
Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud – Virtualization – Load Balancing – Scalability and Elasticity – Replication – Monitoring – Cloud Services and Platforms: Compute Services – Storage Services – Application Services		

Course Outcomes:	
CO1:	Explain the foundations of distributed systems (K2)
CO2:	Solve synchronization and state consistency problems (K3)
CO3:	Use resource sharing techniques in distributed systems (K3)
CO4:	Apply working model of consensus and reliability of distributed systems (K3)
CO5:	Explain the fundamentals of cloud computing (K2)

Textbooks:	
1.	Kshemkalyani Ajay D, Mukesh Singhal, "Distributed Computing: Principles, Algorithms and Systems", Cambridge Press, 2011.
2.	Mukesh Singhal, Niranjan G Shivaratri, "Advanced Concepts in Operating systems", Mc-Graw Hill Publishers, 1994

Reference books/other materials/webresources:	
1.	George Coulouris, Jean Dollimore, Time Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.....
2.	Pradeep L Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007
3.	Tanenbaum A S, Van Steen M, "Distributed Systems: Principles and Paradigms", Pearson Education, 2007
4.	Liu M L, "Distributed Computing: Principles and Applications", Pearson Education, 2004
5.	Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, 2003.

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6.	Arshdeep Bagga, Vijay Madisetti, " Cloud Computing: A Hands-On Approach", Universities Press, 2014

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	2	3	3	1			2	1	3	3	2	1	1
CO2:	1	3	2	1	2			2	2	2	2	1	3	2
CO3:	2	2	1	3	3			3	2	1	1	1	2	1
CO4:	1	2	2	3	1			3	3	2	1	3	1	1
CO5:	3	3	1	2	3			3	3	3	1	3	2	3
Average:	1.8	2.4	1.8	2.4	2			2.6	2.2	2.2	1.6	2	1.8	1.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24611	**INTELLIGENT SYSTEMS LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

COURSE OBJECTIVES:

- To understand AI applications in maps, navigation, and recommendation systems.
- To implement facial recognition and image processing techniques.
- To develop text-based applications like autocorrect and chatbots.
- To explore sentiment analysis and fake news detection using NLP.
- To apply AI in social media, digital assistants, and real-world problem-solving

LIST OF EXPERIMENTS

1. Maps and Navigation.
2. Facial Detection and Recognition.
3. Text Editors or Autocorrect.
4. Search and Recommendation Algorithms.
5. Chatbots.
6. Digital Assistants.
7. Social Media.
8. Image Processing.
9. Sentiment Analysis.
10. Fake News Detection using NLP.

Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain AI techniques used in navigation and recommendation systems
CO2:	Implement facial detection and recognition models

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CO3:	Develop text editors with autocorrect features.
CO4:	Apply AI for chatbots and digital assistants.
CO5:	Use AI for social media insights and content moderation

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

MINI PROJECT

SEMESTER VII

Subject Code	Subject Name	Category	L	T	P	C
GE24902	**HUMAN VALUES AND ETHICS**	**HSMC**	**2**	**0**	**0**	**2**

Course Objectives:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students' minds and develop their critical thinking.

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- To promote sense of responsibility and understanding of the duties of citizen.

UNIT – I	**DEMOCRATIC VALUES**	**6**
Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement Reading Text: Excerpts from John Stuart Mills' On Liberty		
UNIT – II	**SECULAR VALUES**	**6**
Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices. Reading Text: Excerpt from Secularism in India: Concept and Practice by Ram Puniyani		
UNIT – III	**SCIENTIFIC VALUES**	**6**
Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper. Reading Text: Excerpt from The Scientific Temper by Antony Michaelis R		
UNIT – IV	**SOCIAL ETHICS**	**6**
Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices. Reading Text: Excerpt from 21 Lessons for the 21st Century by Yuval Noah Harari		
UNIT – V	**SCIENTIFIC ETHICS**	**6**
Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society. Reading Text: Excerpt from American Prometheus: The Triumph and Tragedy of J.Robert Oppenheimer by Kai Bird and Martin J. Sherwin.		
		Total Contact Hours : 30

Course Outcomes:	Students will be able to
CO1:	Identify the importance of democratic, secular and scientific values in harmonious functioning of social life.
CO2:	Practice democratic and scientific values in both their personal and professional life.
CO3:	Find rational solutions to social problems.
CO4:	Behave in an ethical manner in society.

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CO5:	Practice critical thinking and the pursuit of truth.

Reference books:	
1.	The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2.	Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3.	The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4.	The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press.
5.	Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022.

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CB24701	**DATA AND INFORMATION SECURITY**	**PCC**	**3**	**0**	**0**	**3**
Course Objectives:						
• To understand the basics of Information Security						
• To know the legal, ethical and professional issues in Information Security						
• To equip the students' knowledge on digital signature, email security and web security						

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UNIT – I	**INTRODUCTION**	**9**
History, What is Information Security?, Critical Characteristics of Information,NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC		
UNIT – II	**SECURITY INVESTIGATION**	**9**
Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues – An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies		
UNIT – III	**DIGITAL SIGNATURE AND AUTHENTICATION**	**9**
Digital Signature and Authentication Schemes: Digital signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview- Requirements Protocols - Applications - Kerberos -X.509 Directory Services		
UNIT – IV	**E-MAIL AND IP SECURITY**	**9**
E-mail and IP Security: Electronic mail security: Email Architecture -PGP – Operational Descriptions Key management- Trust Model- S/MIME.IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management.		
UNIT – V	**WEB SECURITY**	**9**
Web Security: Requirements- Secure Sockets Layer- Objectives-Layers –SSL secure communication-Protocols - Transport Level Security. Secure Electronic Transaction- Entities DS Verification-SET processing.		
	Total Contact Hours : 45	

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the basics of data and information security.
CO2:	Understand the legal, ethical and professional issues in information security.
CO3:	Understand the various authentication schemes to simulate different applications.
CO4:	Understand various security practices and system security standards.
CO5:	Understand the Web security protocols for E-Commerce applications .

Textbooks:	
1.	Michael E Whitman and Herbert J Mattord, “Principles of Information Security, Course
2.	Technology, 6th Edition, 2017.
3.	Stallings William. Cryptography and Network Security: Principles and Practice, Seventh Edition, Pearson Education, 2017.

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Reference books/other materials/webresources:	
1.	Harold F. Tipton, Micki Krause Nozaki,, "Information Security Management Handbook, Volume 6, 6th Edition, 2016.
2.	Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", McGraw- Hill, Seventh Edition, 2012.
3.	Matt Bishop, "Computer Security Art and Science, Addison Wesley Reprint Edition, 2015.
4	Behrouz A Forouzan, Debdeep Mukhopadhyay, Cryptography And network security, 3rd Edition, . McGraw-Hill Education, 2015

	CO-PO Mapping											CO-PSO Mapping		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

Subject Code	Subject Name	Category	L	T	P	C
CB24711	**DATA SECURITY LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

Course Objectives:

- To learn different cipher techniques.
- To implement the algorithms DES,RSA,MD5,SHA-1
- To use network security tools and vulnerability assessment tools.

LIST OF EXPERIMENTS

1. Perform encryption, decryption using the following substitution techniques.
   (i) Ceaser cipher (ii) Playfair cipher (iii) Hill Cipher (iv) Vigenere cipher
2. Perform encryption and decryption using following transposition techniques
   i)Railfence ii)Row& Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript.
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.

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7. Calculate the message digest of a text using the SHA-1algorithm.	
8. Implement the SIGNATURESCHEME-Digital Signature Standard.	
9. Demonstrate intrusion detection system (ids) using any tool eg.Snort or any others.	
10. Automated Attack and Penetration Tools.	
11. Exploring N-Stalker ,a Vulnerability Assessment Tool.	
12. Defeating Malware i)Building Trojans ii)Rootkit Hunter.	
	Total Contact Hours :45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Develop code for classical Encryption Techniques to solve the problems.
CO2:	Build cryptosystems by applying symmetric and public key encryption algorithms.
CO3:	Construct code for authentication algorithms.
CO4:	Develop a signature scheme using Digital signature standard.
CO5:	Demonstrate the network security system using open source tools.

	CO-PO Mapping											**CO-PSO Mapping**		
PO & PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24712	**COMPUTATIONAL LEARNING LABORATORY**	**PCC**	**0**	**0**	**3**	**1.5**

Course Objectives:

- To understand the data sets and apply suitable algorithms for selecting the appropriate features for analysis.
- To learn to implement supervised machine learning algorithms on standard data sets and evaluate the performance.

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• To experiment the unsupervised machine learning algorithms on standard datasets and evaluate the performance.
• To build the graph based learning models for standard datasets.
• To compare the performance of different ML algorithms and select the suitable one based on the application.
LIST OF EXPERIMENTS
1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
4. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file and compute the accuracy with a few test data sets.
5. Implement naïve Bayesian Classifier model to classify a set of documents and measure the accuracy, precision, and recall.
6. Write a program to construct a Bayesian network **to** diagnose CORONA infection using standard WHO Data Set.
7. Image Classification using Logistic Regression on the MNIST Dataset
8. Building a Convolutional Neural Network (CNN) for Image Classification on CIFAR-10 Dataset
9. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select an appropriate data set for your experiment and draw graphs.
Total Contact Hours : 45

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Apply suitable algorithms for selecting the appropriate features for analysis..
CO2:	Implement supervised machine learning algorithms on standard datasets and evaluate the performance
CO3:	Apply unsupervised machine learning algorithms on standard datasets and evaluate the performance
CO4:	Build the graph based learning models for standard datasets.
CO5:	Assess and compare the performance of different ML algorithms and select the

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	suitable one based on the application.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	1	1	1	-	-	3	2	3	2	3	3	2
CO2:	1	3	2	2	2	-	-	3	2	2	2	1	3	1
CO3:	3	2	1	2	1	-	-	2	3	1	1	2	3	3
CO4:	3	3	1	2	1	-	-	1	3	2	2	3	2	2
CO5:	3	3	3	3	2	-	-	1	2	3	1	3	3	2
Average:	2.6	2.6	1.6	2	1.4	-	-	2	2.4	2.2	1.6	2.4	2.8	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
AD24711	**SUMMER INTERNSHIP**	**EEC**	**0**	**0**	**0**	**2**

Course Objectives:

- Get connected with reputed industry/ laboratory/academia / research institute.
- Get practical knowledge on Product Development / Services and operations / Software Design and Development / Testing / Analytics/ research/ startups/ professionalism / business processes and insights / domain knowledge/ Industry Practices/ and other related aspects and develop skills to solve related problems.
- Develop technical, soft, team skills to cater to the needs of the industry / academia / businesses / research / organizations in the core aspects of Automation, Digitalization.

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

Course Outcomes:	On completion of the course, the student will know about
CO1:	Industry Practices, Processes, Techniques, technology, automation and other core aspects of software industry.
CO2:	Analyze, Design solutions to complex business problems.
CO3:	Build and deploy solutions for target platform.
CO4:	Preparation of Technical reports and presentation.

SEMESTER- VIII

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Subject Code	Subject Name	Category	L	T	P	C
AD24811	PROJECT WORK	EEC	0	0	20	10

Course Objectives:

- To train the students for gaining domain knowledge, and technical skills to solve potential business / research problems.
- Gather requirements and Design suitable software solutions and evaluate alternatives.
- To work in small teams and understand the processes and practices in the 'industry.
- Implement, Test and deploy solutions for target platforms.
- Preparing project reports and presentation.

The students shall individually / or as group work on business/research domains and related problems approved by the Department / organization that offered the internship / project.

The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

Course Outcomes:	At the end of the project, the student will be able to
CO1:	Gain Domain knowledge and technical skill set required for solving industry / research problems.
CO2:	Provide solution architecture, module level designs, algorithms.
CO3:	Implement, test and deploy the solution for the target platform.
CO4:	Prepare detailed technical report, demonstrate and present the work.

PROFESSIONAL ELECTIVE COURSES:VERTICAL-I

Subject Code	Subject Name	Category	L	T	P	C
CCS2405	KNOWLEDGE ENGINEERING	PEC	2	0	2	3

Course Objectives:

- To understand the basics of Knowledge Engineering.
- To discuss methodologies and modeling for Agent Design and Development.

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• To design and develop ontologies.
• To apply reasoning with ontologies and rules.
• To understand learning and rule learning.

UNIT – I	**REASONING UNDER UNCERTAINTY**	**6**
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.		
UNIT – II	**METHODOLOGY AND MODELING**	**6**
Conventional Design and Development – Development tools and Reusable Ontologies – Agent Design and Development using Learning Technology – Problem Solving through Analysis and Synthesis – Inquiry-driven Analysis and Synthesis – Evidence-based Assessment – Believability Assessment – Drill-Down Analysis, Assumption-based Reasoning, and What-If Scenarios.		
UNIT – III	**ONTOLOGIES – DESIGN AND DEVELOPMENT**	**6**
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 – Modeling-based Ontology Specification.		
UNIT – IV	**REASONIING WITH ONTOLOGIES AND RULES**	**6**
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 K		
UNIT – V	**LEARNING AND RULE LEARNING**	**6**
Machine Learning – Concepts – Generalization and Specialization Rules – Types – Formal definition of Generalization. Modelling, Learning and Problem Solving – Rule learning and Refinement – Overview – Rule Generation and Analysis – Hypothesis Learning.		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1. Perform operations with Evidence Based Reasoning.
2. Perform Evidence based Analysis.
3. Perform operations on Probability Based Reasoning.
4. Perform Believability Analysis.
5. Implement Rule Learning and refinement.
6. Perform analysis based on learned patterns
7. Construction of Ontology for a given domain.

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	Total Contact Hours : 30

Course Outcomes:	**At the end of this course, the students will be able to:**
CO1:	Understand the basics of Knowledge Engineering.
CO2:	Apply methodologies and modelling for Agent Design and Development.
CO3:	Design and develop ontologies.
CO4:	Apply reasoning with ontologies and rules.
CO5:	Understand learning and rule learning.

Textbooks:	
1.	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 1 – Chapter 1 / Unit 2 – Chapter 3,4 / Unit 3 – Chapter 5, 6 / Unit 4 - 7 , Unit 5 – Chapter 8, 9)

Reference books/other materials/webresources:	
1.	Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2.	Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
3.	John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
4.	King , Knowledge Management and Organizational Learning , Springer, 2009.
5.	Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	1	1	1	1	-	1	2	1	2	1	1	1
CO2:	3	2	3	2	2	-	-	2	1	2	1	3	3	1
CO3:	2	2	3	2	2	-	-	3	2	2	2	3	2	3
CO4:	2	2	3	1	1	-	-	2	2	2	2	2	1	1
CO5:	2	2	2	1	1	-	-	2	1	1	1	2	1	1
Average:	2.4	1.8	2.4	1.4	1.4	0.2	-	2	1.6	1.3	1.6	2.2	1.6	1.4

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2406	**SOFT COMPUTING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To learn various evolutionary Algorithms.

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• To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
• To introduce case studies utilizing the above and illustrate the Intelligent behavior of programs based on soft computing

UNIT – I	**INTRODUCTION TO SOFT COMPUTING AND FUZZY LOGIC**	**6**
Introduction - Fuzzy Logic - Fuzzy Sets, Fuzzy Membership Functions, Operations on Fuzzy Sets, Fuzzy Relations, Operations on Fuzzy Relations, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems.		
UNIT – II	**NEURAL NETWORKS**	**6**
Supervised Learning Neural Networks – Perceptrons - Backpropagation -Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks		
UNIT – III	**GENETIC ALGORITHMS**	**6**
Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function		
UNIT – IV	**NEURO FUZZY MODELING**	**6**
ANFIS architecture – hybrid learning – ANFIS as universal approximator – Coactive Neuro fuzzy modeling – Framework – Neuron functions for adaptive networks – Neuro fuzzy spectrum - Analysis of Adaptive Learning Capability		
UNIT – V	**APPLICATIONS**	**6**
Modeling a two input sine function - Printed Character Recognition – Fuzzy filtered neural networks – Plasma Spectrum Analysis – Hand written neural recognition - Soft Computing for Color Recipe Prediction.		
	Total Contact Hours : 30	

LIST OF EXPERIMENTS
1. Implementation of fuzzy control/ inference system
2. Programming exercise on classification with a discrete perceptron
3. Implementation of XOR with backpropagation algorithm
4. Implementation of self organizing maps for a specific application
5. Programming exercises on maximizing a function using Genetic algorithm.
6. Implementation of two input sine function
7. Implementation of three input non linear function.

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	Total Contact Hours : 30

Course Outcomes:	
CO1:	Understand the fundamentals of fuzzy logic operators and inference mechanisms.
CO2:	Understand neural network architecture for AI applications such as classification and clustering.
CO3:	Learn the functionality of Genetic Algorithms in Optimization problems.
CO4:	Use hybrid techniques involving Neural networks and Fuzzy logic.
CO5:	Apply soft computing techniques in real world applications.

Textbooks:	
1.	SaJANG, J.-S. R., SUN, C.-T., & MIZUTANI, E. (1997). Neuro-fuzzy and soft computing: A computational approach to learning and machine intelligence. Upper Saddle River, NJ, Prentice Hall,1997
2.	Himanshu Singh, Yunis Ahmad Lone, Deep Neuro-Fuzzy Systems with Python.
3.	With Case Studies and Applications from the Industry, Apress, 2020

Reference books/other materials/webresources:	
1.	Roj Kaushik and Sunita Tiwari, Soft Computing-Fundamentals Techniques and Applications, 1st Edition, McGraw Hill, 2018.
2.	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
3.	Samir Roy, Udit Chakraborthy, Introduction to Soft Computing, Neuro Fuzzy and Genetic Algorithms, Pearson Education, 2013.
4.	S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, Third Edition, Wiley India Pvt Ltd, 2019.
5.	R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	3	3	-	-	3	1	3	2	3	1	2
CO2:	2	3	3	2	3	-	-	3	2	3	2	2	1	3
CO3:	1	3	2	2	1	-	-	3	1	1	2	1	3	2
CO4:	1	2	1	3	2	-	-	3	3	1	1	2	1	1
CO5:	2	3	1	2	1	-	-	3	3	3	2	1	2	3
Average:	1.8	2.6	2	2.4	2	-	-	3	2	2.2	1.8	1.8	1.6	2.2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2407	TEXT AND SPEECH ANALYSIS	PEC	2	0	2	3

Course Objectives:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- To Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT – I	NATURAL LANGUAGE BASICS	6

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop-words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

Suggested Activities

- Flipped classroom on NLP
- Implementation of Text Preprocessing using NLTK
- Implementation of TF-IDF models

Suggested Evaluation Methods

- Quiz on NLP Basics
- Demonstration of Programs

UNIT – II	TEXT CLASSIFICATION	6

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models.

Suggested Activities

- Flipped classroom on Feature extraction of documents
- Implementation of SVM models for text classification
- External learning: Text summarization and Topic models

Suggested Evaluation Methods

- Assignment on above topics
- Quiz on RNN, Transformers
- Implementing NLP with RNN and Transformers.

UNIT – III	QUESTION ANSWERING AND DIALOGUE SYSTEMS	6

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Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems.

Suggested Activities:

• Flipped classroom on language models for QA
• Developing a knowledge-based question-answering system
• Classic QA model development

Suggested Evaluation Methods

• Assignment on the above topics
• Quiz on knowledge-based question answering system
• Development of simple chatbots

UNIT – IV	**TEXT-TO-SPEECH SYNTHESIS**	**6**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems.

Suggested Activities:

• Flipped classroom on Speech signal processing
• Exploring Text normalization
• Data collection
• Implementation of TTS systems

Suggested Evaluation Methods

• Assignment on the above topics
• Quiz on wavenet, deep learning-based TTS systems
• Finding accuracy with different TTS systems

UNIT – V	**AUTOMATIC SPEECH RECOGNITION**	**6**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

Suggested Activities:

• Flipped classroom on Speech recognition.
• Exploring Feature extraction

Suggested Evaluation Methods

• Assignment on the above topics
• Quiz on acoustic modeling

Total Contact Hours : 30

LIST OF EXPERIMENTS
1. Create Regular expressions in Python for detecting word patterns and tokenizing text
2.Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams
3.Accessing Text Corpora using NLTK in Python
4.Write a function that finds the 50 most frequently occurring words of a text that are not stop wor
5.Implement the Word2Vec model
6.Use a transformer for implementing classification
7.Design a chatbot with a simple dialog system

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8.Convert text to speech and find accuracy	
9.Design a speech recognition system and find the error rate	
	Total Contact Hours : 30

Course Outcomes:	On completion of the course, the students will be able to
CO1:	Explain existing and emerging deep learning architectures for text and speech processing
CO2:	Apply deep learning techniques for NLP tasks, language modelling and machine translation.
CO3:	Explain coreference and coherence for text processing.
CO4:	Build question-answering systems, chatbots and dialogue systems.
CO5:	Apply deep learning models for building speech recognition and text-to-speech systems.

Textbooks:	
1.	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

Reference books/other materials/webresources:	
1.	Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2.	Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3.	Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4.	Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	1	3	-	-	1	2	1	2	1	1	1
CO2:	3	1	2	1	3	-	-	2	2	1	3	3	2	1
CO3:	2	2	1	3	1	-	-	3	3	1	2	3	3	1
CO4:	2	1	1	1	2	-	-	2	1	2	2	3	1	1
CO5:	1	3	2	2	1	-	-	3	2	1	1	2	3	1
Average:	2.2	1.8	1.8	1.6	2	-	-	2.2	2	1.2	2	2.4	2	1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**

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CCS2402	ETHICS AND AI	PEC	2	0	2	3

Course Objectives:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT – I	INTRODUCTION	6

Definition of morality and ethics in AI-Impact on society-Impact on human psychology-Impact on the legal system-Impact on the environment and the planet-Impact on trust

UNIT – II	ETHICAL INITIATIVES IN AI	6

International ethical initiatives-Ethical harms and concerns-Case study: healthcare robots, Autonomous Vehicles , Warfare and weaponization.

UNIT – III	AI STANDARDS AND REGULATION	6

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems

UNIT – IV	ROBO ETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS	6

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT – V	AI AND ETHICS- CHALLENGES AND OPPORTUNITIES	6

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries- National and International Strategies on AI.

Total Contact Hours : 30

LIST OF EXPERIMENTS

1. Recent case study of ethical initiatives in healthcare, autonomous vehicles and defense
2. Exploratory data analysis on a 2 variable linear regression model
3. Experiment the regression model without a bias and with bias
4. Classification of a dataset from UCI repository using a perceptron with and without bias
5. Case study on ontology where ethics is at stake
6. Identification on optimization in AI affecting ethics

Total Contact Hours : 30

Course Outcomes:	On completion of the course, the students will be able to

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CO1:	Learn about morality and ethics in AI speech processing
CO2:	Acquire the knowledge of real time application ethics, issues and its challenges.
CO3:	Understand the ethical harms and ethical initiatives in AI
CO4:	Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
CO5:	Understand the concepts of Roboethics and Morality with professional responsibilities.
CO6:	Learn about the societal issues in AI with National and International Strategies on AI

Textbooks:	
1.	y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2.	Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

Reference books/other materials/web resources:	
1.	Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2.	Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

Reference books/other materials/webresources:	
1.	https://sci-hub.mksa.top/10.1007/978-3-540-30301-5_65
2.	https://www.scu.edu/ethics/all-about-ethics/artificial-intelligence-and-ethics-sixteen challenges-and-opportunities/
3.	https://www.weforum.org/agenda/2016/10/top-10-ethical-issues-in-artificial-intelligence/
4.	https://sci-hub.mksa.top/10.1159/000492428

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	3	1	-	-	1	2	1	1	3	1	1
CO2:	2	1	1	2	1	-	-	1	2	1	1	3	3	1
CO3:	2	3	1	1	3	-	-	2	1	1	2	3	2	2
CO4:	3	1	3	3	2	-	-	2	2	3	1	2	1	3
CO5:	3	1	1	3	3	-	-	2	3	3	3	1	3	3
Average:	2.6	1.6	1.8	2.4	2	-	-	1.6	2	1.8	1.6	2.4	2	2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2436	IMAGE AND VIDEO ANALYTICS	PEC	2	0	2	3

Course Objectives:

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the video analytics techniques.

UNIT – I	**INTRODUCTION**	**6**

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**	**6**

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 speralct images - Local pre-processing in the frequency domain - Line detection by local pre processing operators - Image restoration.

UNIT – III	**OBJECT DETECTION USING MACHINE LEARNING**	**6**

Object detection– Object detection methods – Deep Learning framework for Object detection bounding box approach-Intersection over Union (IoU) –Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

UNIT – IV	**FACE RECOGNITION AND GESTURE RECOGNITION**	**6**

Face Recognition-Introduction-Applications of Face Recognition-Process of Face Recognition-DeepFace solution by Facebook-FaceNet for Face Recognition- Implementation using FaceNet Gesture Recognition.

UNIT – V	**VIDEO ANALYTICS**	**6**

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem RestNet architecture-RestNet and skip connections-Inception Network-GoogleNet architecture Improvement in Inception v2-Video analytics-RestNet and Inception v3.

Total Contact Hours : 30

LIST OF EXPERIMENTS

1. Write a program that computes the T-pyramid of an image.
2. Write a program that derives the quad tree representation of an image using the homogeneity criterion of equal intensity
3. Develop programs for the following geometric transforms: (a) Rotation (b) Change of scale (c) Skewing (d) Affine transform calculated from three pairs of corresponding points (e) Bilinear transform calculated from four pairs of corresponding points.

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4. Develop a program to implement Object Detection and Recognition	
5. Develop a program for motion analysis using moving edges and apply it to your image sequences	
6. Develop a program for Facial Detection and Recognition	
7.Write a program for event detection in video surveillance system	
	Total Contact Hours : 30

Course 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:	Develop various object detection techniques.
CO4:	Understand the various face recognition mechanisms.
CO5:	Elaborate on deep learning-based video analytics.

Textbooks:	
1.	Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", 4nd edition, Thomson Learning, 2013.
2.	Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021(UNIT-III,IV and V)

Reference books/other materials/webresources:	
1.	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.
2.	Caifeng Shan, FatihPorikli, 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, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	2	2	2	-	-	3	3	2	1	2	1	3
CO2:	2	2	3	3	3	-	-	3	2	1	1	2	2	1
CO3:	1	2	2	2	3	-	-	1	2	1	2	1	1	3
CO4:	1	2	3	2	3	-	-	2	2	2	3	2	2	2
CO5:	3	2	1	3	2	-	-	2	1	1	3	3	2	1
Average:	2	1.8	2.2	2.4	2.6	-	-	2.2	2	1.4	2	2	1.6	2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2437	COMPUTER VISION	PEC	2	0	2	3

Course 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**	**6**
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**	**6**
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**	**6**
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**	**6**
Shape from X - Active rangefinding - Surface representations - Point-based representations- Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.		
UNIT – V	**IMAGE-BASED RENDERING AND RECOGNITION**	**6**
View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.		
	Total Contact Hours : 30	

LIST OF EXPERIMENTS

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OpenCV computer vision Library for OpenCV in Python / PyCharm or C++ / Visual Studio or or equivalent

- OpenCV Installation and working with Python
- Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection
- Image Annotation – Drawing lines, text circle, rectangle, ellipse on images

Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection

- Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment
- Image segmentation using Graphcut / Grabcut
- Camera Calibration with circular grid
- Pose Estimation
- 3D Reconstruction – Creating Depth map from stereo images
- Object Detection and Tracking using Kalman Filter, Camshift

1. docs.opencv.org
2. https://opencv.org/opencv-free-course/

	Total Contact Hours : 30

Course Outcomes:	**At the end of this course, the students will be able to:**
CO1:	To understand basic knowledge, theories and methods in image processing and computer vision..
CO2:	To implement basic and some advanced image processing techniques in OpenCV.
CO3:	To apply 2D a feature-based based image alignment, segmentation and motion estimations.
CO4:	To apply 3D image reconstruction techniques
CO5:	To design and develop innovative image processing and computer vision applications.

Textbooks:	
1.	Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer- Texts in Computer Science, Second Edition, 2022.
2.	Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

Reference books/other materials/webresources:	
1.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

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2.	Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3.	E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	1	1	1	-	-	2	1	3	2	2	1	1
CO2:	3	3	3	2	3	-	-	2	1	2	2	3	1	2
CO3:	3	3	2	2	3	-	-	1	1	2	2	3	2	2
CO4:	2	3	3	2	3	-	-	2	1	2	3	2	2	3
CO5:	2	3	3	2	2	2	-	3	1	2	3	3	3	3
Average:	2.6	2.6	2.4	1.8	2.4	0.4	0	2	1	2.2	2.4	2.6	1.8	2.2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2435	**EXPLORATORY DATA ANALYSIS**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To outline an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.

UNIT – I	**EXPLORATORY DATA ANALYSIS**	**6**
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.		
UNIT – II	**EDA USING PYTHON**	**6**
Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.		
UNIT – III	**UNIVARIATE ANALYSIS**	**6**
Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – In		
UNIT – IV	**BIVARIATE ANALYSIS**	**6**
Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines.		
UNIT – V	**MULTIVARIATE AND TIME SERIES ANALYSIS**	**6**
Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time based indexing		

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– Visualizing – Grouping – Resampling.	
	Total Contact Hours : 30

LIST OF EXPERIMENTS	
1. Install the data Analysis and Visualization tool: R/ Python /Tableau Public/ Power BI.	
2. Perform exploratory data analysis (EDA) with datasets like email data set. Export all your Emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data.	
3. Working with Numpy arrays, Pandas data frames , Basic plots using Matplotlib.	
4. Explore various variable and row filters in R for cleaning data. Apply various plot features in R on sample data sets and visualize.	
5. Perform Time Series Analysis and apply the various visualization techniques.	
6. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc..	
7. Build cartographic visualization for multiple datasets involving various countries of the world states and districts in India etc.	
8. Perform EDA on Wine Quality Data Set.	
9. Use a case study on a data set and apply the various EDA and visualization techniques and present an analysis report.	
	Total Contact Hours : 30

Course Outcomes:	**At the end of this course, the students will be able to:**
CO1:	Understand the fundamentals of exploratory data analysis.
CO2:	Implement the data visualization using Matplotlib.
CO3:	Perform univariate data exploration and analysis.
CO4:	Apply bivariate data exploration and analysis.
CO5:	Use Data exploration and visualization techniques for multivariate and time series data.

Textbooks:	
1.	Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python”, Packt Publishing, 2020. (Unit 1)
2.	Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017. (Unit 2)
3.	Catherine Marsh, Jane Elliott, “Exploring Data: An Introduction to Data Analysis for Social Scientists”, Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)

Reference books/other materials/webresources:	
1.	Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.

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2.	Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly publications, 2019.
3.	Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	3	3	-	-	2	2	3	2	3	3	2
CO2:	2	2	2	3	3	-	-	3	2	2	2	1	2	3
CO3:	2	3	2	2	3	-	-	2	2	2	1	2	3	1
CO4:	2	2	2	2	3	-	-	3	2	2	1	2	2	2
CO5:	2	2	3	2	1	-	-	1	2	2	1	2	2	3
Average:	2.2	2.2	2.4	2.4	2.6	-	-	2.2	2	2.2	1.4	2	2.4	2.2

PROFESSIONAL ELECTIVE COURSES:VERTICAL-II

Subject Code	Subject Name	Category	L	T	P	C
CCS2408	**APP DEVELOPMENT**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To learn development of native applications with basic GUI Components
- To develop cross-platform applications with event handling
- To develop applications with location and data storage capabilities
- To develop web applications with database access
- To learn development of native applications with basic GUI Components

UNIT – I	**FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT**	**6**
Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design,		
UNIT – II	**NATIVE APP DEVELOPMENT USING JAVA**	**6**
Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS, Basics of React Native, Native Components, JSX, State, Props		
UNIT – III	**HYBRID APP DEVELOPMENT**	**6**
Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova,		
UNIT – IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**	**6**

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What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross-platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props		
UNIT – V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**	**6**
Comparison of different Ap p frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1 .Using react native, build a cross platform application for a BMI calculator.
2. Build a cross platform application for a simple expense manager which allows entering expenses and income on each day and displays category wise weekly income and expense.
3. Develop a cross platform application to convert units from imperial system to metric system (km to miles, kg to pounds etc.,)
4. Design and develop a cross platform application for day to day task (to-do) management.
5. Design an android application using Cordova for a user login screen with username, password, reset button and a submit button. Also, include header image and a label. Use layout managers
6. Design and develop an android application using Apache Cordova to find and display the current location of the user.
7. Write programs using Java to create Android application having Databases ● For a simple library application. ● For displaying books available, books lend, book reservation. Assume that student information is available in a database which has been stored in a database server.
Total Contact Hours : 30

Course Outcomes:	**At the end of this course, the students will be able to:**
CO1:	Develop Native applications with GUI Components.
CO2:	Develop hybrid applications with basic event handling.
CO3:	Implement cross-platform applications with location and data storage capabilities.
CO4:	Implement cross platform applications with basic GUI and event handling.
CO5:	Develop web applications with cloud database access.

Textbooks:	
1.	Head First Android Development, Dawn Griffiths, O'Reilly, 1st edition
2.	Apache Cordova in Action, Raymond K. Camden, Manning. 2015
3.	Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native, Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott, FullStack publishing

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Reference books/other materials/web resources:	
1.	Android Programming for Beginners, John Horton, Packt Publishing, 2nd Edition
2.	Native Mobile Development by Shaun Lewis, Mike Dunn
3.	Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach, Pawan Lingras, Matt Triff, Rucha Lingras
4.	Apache Cordova 4 Programming, John M Wargo, 2015
5.	React Native Cookbook, Daniel Ward, Packt Publishing, 2nd Edition

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	2	1	2	3	-	-	1	1	2	1	2	3	3
CO2:	2	1	3	2	2	-	-	3	2	2	3	3	2	1
CO3:	2	2	2	1	2	-	-	1	1	1	1	1	1	2
CO4:	1	3	1	1	3	-	-	1	1	3	2	1	3	1
CO5:	1	1	3	1	3	--	-	1	1	2	1	3	2	1
Average:	1.6	1.8	2	1.4	2.6	-	-	1.4	1.2	2	1.6	2	2.2	1.6

Subject Code	Subject Name	Category	L	T	P	C
CCS2445	**INTERNET PROGRAMMING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand different Internet Technologies
- To learn java-specific web services architecture
- To Develop web applications using frameworks

UNIT – I	**WEBSITE BASICS,HTML5,CSS3,WEB2.0**	**7**
Web Essentials: Clients, Servers and Communication – The Internet – World wide web – HTTP Request Message–HTTPResponseMessage –WebClients –WebServers –HTML5–Tables– Lists – Image – HTML5 control 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. Bootstrap Framework		
UNIT – II	**CLIENT SIDE PROGRAMMING**	**6**
Java Script: An introduction to JavaScript–JavaScript DOM Model-Exception Handling-Validation-Built-in objects-Event Handling- DHTML with JavaScript- JSON introduction – Syntax – Function Files.		
UNIT – III	**SERVER SIDE PROGRAMMING**	**5**
Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC.		
UNIT – IV	**PHP AND XML**	**6**
An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation. XML: Basic XML- Document Type Definition- XML Schema, XML Parsers and Validation, XSL		
UNIT – V	**INTRODUCTION TO ANGULAR AND WEB APPLICATIONS**	**6**

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	FRAMEWORKS	
Introduction to AngularJS, MVC Architecture, Understanding ng attributes, Expressions and data binding, Conditional Directives, Style Directives, Controllers, Filters, Forms, Routers, Modules, Services; Web Applications Frameworks and Tools – Firebase- Docker- Node JS- React- Django- UI & UX.		
	Total Contact Hours : 30	

LIST OF EXPERIMENTS	
1	Create a webpage with the following using HTML. To embed an image map in a webpage. To fix the hotspots. Show all the related information when the hotspots are clicked.
2	Create a webpage with all types of Cascading style sheets.
3	ClientSide Scripts for Validating WebForm Controls using DHTML.
4	Installation of Apache Tomcat webserver.
5	Write programs in Java using Servlets:
6	To invoke servlets from HTML forms.
7	Session Tracking.
8	Write programs in Java to create three-tier applications using JSP and Databases For conducting on-line examination. For displaying studentmarklist. Assume that student information is available in a database which has been stored in a database server.
9.	Programs using XML–Schema–XSLT/XSL.
	Total Contact Hours: 30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Construct a basic website using HTML and Cascading Style Sheets
CO2:	Build dynamic webpage with validation using JavaScript objects and by applying different event handling mechanisms.
CO3:	Develop server side programs using Servlets and JSP.
CO4:	Construct simple webpages in PHP and to represent data in XML format.
CO5:	Develop interactive web applications

Textbooks:	
1.	Deitel and Deitel and Nieto, Internet and World Wide Web - How to Program, Prentice Hall, 5th Edition, 2011.
2.	Jeffrey C and Jackson, Web Technologies A Computer Science Perspective, Pearson Education, 2011.
3.	Angular 6 for Enterprise-Ready Web Applications, Doguhan Uluca, 1st edition, Packt Publishing

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Reference books/other materials/webresources:	
1.	Stephen Wynkoop and John Burke—Running a PerfectWebsite‖,QUE, 2ndEdition,1999.
2.	ChrisBates,Web Programming–Building Intranet Applications,3rdEdition,Wiley Publications, 2009.
3.	GopalanN.P. and Akilandeswari J., —Web Technology‖, Prentice Hall of India,2011.
4	UttamK.Roy, —WebTechnologies‖,Oxford University Press,2011.
5	Angular: Up and Running: Learning Angular, Step by Step, Shyam Seshadri, 1st edition,OReilly

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	3	2	3	3	3	-	-	1	3	3	1	3	2	3
CO2:	2	2	2	1	2	-	-	2	2	1	3	2	2	2
CO3:	1	1	3	2	3	-	-	1	2	1	1	1	2	1
CO4:	2	3	3	1	2	-	-	3	1	2	2	2	2	2
CO5:	1	2	3	2	2	-	-	2	1	3	1	1	1	2
Average:	1.8	2	2.8	1.8	2.4	-	-	1.8	1.8	2	1.6	1.8	1.8	2

Subject Code	Subject Name	Category	L	T	P	C
CCS2410	UI AND UX DESIGN	PEC	2	0	2	3

Course Objectives:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX
- Creating a wireframe and prototype

UNIT – I	FOUNDATIONS OF DESIGN	6
UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy		
UNIT – II	**FOUNDATIONS OF UI DESIGN**	**6**
Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides		
UNIT – III	**FOUNDATIONS OF UX DESIGN**	**6**
Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals		
UNIT – IV	**WIREFRAMING, PROTOTYPING AND TESTING**	**6**

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Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration		
UNIT – V	**RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE**	**6**
Identifying and Writing Problem Statements - Identifying Appropriate Research Methods - Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1.Designing a Responsive layout for an societal application
2. Exploring various UI Interaction Patterns
3. Developing an interface with proper UI Style Guides
4. Developing Wireflow diagram for application using open source software
5. Exploring various open source collaborative interface Platform
6. Hands on Design Thinking Process for a new product
7. Brainstorming feature for proposed product
8. Defining the Look and Feel of the new Project
9. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on
UI principles)
10. Identify a customer problem to solve
11. Conduct end-to-end user research - User research, creating personas, Ideation
12. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements
Total Contact Hours : 30

Course Outcomes:	On completion of the course, the students will be able to:
CO1:	Build UI for user Applications
CO2:	Evaluate UX design of any product or application
CO3:	Demonstrate UX Skills in product development
CO4:	Implement Sketching principles
CO5:	Create Wireframe and Prototype

Textbooks:	
1.	Joel Marsh, “UX for Beginners”, O’Reilly , 2022

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2.	Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

Reference books/other materials/webresources:	
1.	Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2.	Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3.	Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015
4.	https://www.nngroup.com/articles/
5.	https://www.interaction-design.org/literature.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	1	3	1	-	-	3	3	2	1	3	3	1
CO2:	2	3	1	3	2	-	-	1	2	2	2	1	2	2
CO3:	1	3	3	2	2	-	-	2	3	1	2	1	3	3
CO4:	1	2	3	3	1	-	-	3	2	1	3	3	3	3
CO5:	1	2	3	2	1	--	-	2	1	1	1	3	2	2
Average:	1.6	2.2	2.2	2.6	1.4	-	-	2.2	2.2	1.4	1.8	2.2	2.6	2.2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2411	**SOFTWARE TESTING AND AUTOMATION**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the basics of software testing
- To learn how to do the testing and planning effectively
- To build test cases and execute them
- To focus on wide aspects of testing and understanding multiple facets of testing
- To get an insight about test automation and the tools used for test automation

UNIT – I	**FOUNDATIONS OF SOFTWARE TESTING**	**6**

Why do we test Software?, Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT – II	**TEST PLANNING**	**6**

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

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UNIT – III	TEST DESIGN AND EXECUTION	6
Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.		
UNIT – IV	**ADVANCED TESTING CONCEPTS**	**6**
Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile Applications.		
UNIT – V	**TEST AUTOMATION AND TOOLS**	**6**
Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1. Develop the test plan for testing an e-commerce web/mobile application (www.amazon.in).
2. Design the test cases for testing the e-commerce application
3. Test the e-commerce application and report the defects in it.
4. Develop the test plan and design the test cases for an inventory control system.
5. Execute the test cases against a client server or desktop application and identify the defects.
6. Test the performance of the e-commerce application.
7. Automate the testing of e-commerce applications using Selenium.
8. Integrate TestNG with the above test automation.
9. Mini Project: a) Build a data-driven framework using Selenium and TestNG b) Build Page object Model using Selenium and TestNG c) Build BDD framework with Selenium, TestNG and Cucumber
Total Contact Hours : 30

Course Outcomes:	On completion of the course, the students will be able to:
CO1:	Understand the basic concepts of software testing and the need for software testing
CO2:	Design Test planning and different activities involved in test planning

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CO3:	Design effective test cases that can uncover critical defects in the application
CO4:	Carry out advanced types of testing
CO5:	Automate the software testing using Selenium and TestNG

Textbooks:	
1.	Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2.	Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

Reference books/other materials/webresources:	
1.	Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2.	Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3.	Paul C. Jorgensen, Software Testing: A Craftsman’s Approach, Fourth Edition, 2014, Taylor & Francis Group.
4.	Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing.
5.	Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.
6.	Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.
7.	Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	1	2	-	-	1	1	3	2	3	2	3
CO2:	2	3	1	1	1	-	-	2	2	1	2	1	2	3
CO3:	2	2	1	3	1	-	-	1	3	1	2	2	3	2
CO4:	2	1	3	2	1	-	-	1	1	1	2	3	1	2
CO5:	2	2	1	3	1	-	-	1	3	2	1	2	1	3
Average:	2.2	2.2	1.6	2	1.2	-	-	1.2	2	1.6	1.8	2.2	1.8	2.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2404	**WEB APPLICATION SECURITY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applications
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

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UNIT – I	FUNDAMENTALS OF WEB APPLICATION SECURITY	6
The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, Session Management-Input Validation		
UNIT – II	**SECURE DEVELOPMENT AND DEPLOYMENT**	**5**
Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)		
UNIT – III	**SECURE API DEVELOPMENT**	**6**
API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.		
UNIT – IV	**VULNERABILITY ASSESSMENT AND PENETRATION TESTING**	**6**
Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database based vulnerability scanners, Types of Penetration Tests: External Testing, Web Application Testing, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.		
UNIT – V	**HACKING TECHNIQUES AND TOOLS**	**7**
Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.		
		Total Contact Hours : 30

LIST OF EXPERIMENTS
1. Install wire shark and explore the various protocols a. Analyze the difference between HTTP vs HTTPS b. Analyze the various security mechanisms embedded with different protocols.
2. Identify the vulnerabilities using OWASP ZAP tool
1. Create simple REST API using python for following operation . GET a. PUSH b. POST c. DELETE
2. Install Burp Suite to do following vulnerabilities: . SQL injection a. cross-site scripting (XSS)
5. Attack the website using Social Engineering method
Total Contact Hours : 30

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Course Outcomes:	
CO1:	Understanding the basic concepts of web application security and the need for it
CO2:	Be acquainted with the process for secure development and deployment of web applications
CO3:	Acquire the skill to design and develop Secure Web Applications that use Secure APIs
CO4:	Be able to get the importance of carrying out vulnerability assessment and penetration testing
CO5:	Acquire the skill to think like a hacker and to use hackers tool sets

Textbooks:	
1.	Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern, First Edition, 2020, O'Reilly Media, Inc.
2.	Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, The McGraw-Hill Companies.
3.	Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

Reference books/other materials/webresources:	
1.	Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing, Inc.
2.	Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor & Francis Group, LLC.
3.	Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4.	Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5.	Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and Terron Williams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	1	2	2	1	3	-	-	-	-	--	1	-	-	-
CO2:	2	1	2	1	3	-	-	-	-	-	-	-	-	-
CO3:	1	1	1	2	3	--	-	-	-	-	1	-	-	-
CO4:	1	2	1	1	2	-	-	-	-	-	-	-	-	-
CO5:	1	2	2	2	2	-	-	-	-	--	1	-	-	-
Average:	1.2	1.6	1.6	1.4	2.6	-	-	-	-	-	0.6	-	-	-

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Subject Code	Subject Name	Category	L	T	P	C
CCS2412	DEVOPS	PEC	2	0	2	3

Course Objectives:

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems

UNIT – I	**INTRODUCTION TO DEVOPS**	**6**
Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.		
UNIT – II	**COMPILE AND BUILD USING MAVEN & GRADLE**	**6**
Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle.		
UNIT – III	**CONTINUOUS INTEGRATION USING JENKINS**	**6**
Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.		
UNIT – IV	**CONFIGURATION MANAGEMENT USING ANSIBLE**	**6**
Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible		
UNIT – V	**BUILDING DEVOPS PIPELINES USING AZURE**	**6**
Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file		

LIST OF EXPERIMENTS
1. Create Maven Build pipeline in Azure
2. Run regression tests using Maven Build pipeline in Azure
3. Install Jenkins in Cloud
4. Create CI pipeline using Jenkins
5. Create a CD pipeline in Jenkins and deploy in Cloud
6. Create an Ansible playbook for a simple web application infrastructure
7. Build a simple application using Gradle
8. Install Ansible and configure ansible roles and to write playbooks
Total Contact Hours : 30

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Course Outcomes:	
CO1:	Understand different actions performed through Version control tools like Git.
CO2:	Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
CO3:	Ability to Perform Automated Continuous Deployment
CO4:	Ability to do configuration management using Ansible
CO5:	Understand to leverage Cloud-based DevOps tools using Azure DevOps

Textbooks:	
1.	Roberto Vormittag, "A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises", Second Edition, Kindle Edition, 2016.
2.	Jason Cannon, "Linux for Beginners: An Introduction to the Linux Operating System and Command Line", Kindle Edition, 2014

Reference books/other materials/webresources:	
1.	Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for ... DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh Soni
2.	Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", First Edition, 2015.
3.	David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.
4.	Mariot Tsitoara, "Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer", Second Edition, 2019.
5.	https://www.jenkins.io/user-handbook.pdf
6.	https://maven.apache.org/guides/getting-started/

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO2:	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO3:	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO4:	3	3	3	2	3	-	-	-	-	-	-	2	2	2
CO5:	3	3	3	2	3	-	-	-	-	-	-	2	2	2
Average:	3	3	3	2	3	-	-	-	-	-	-	2	2	2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2413	PRINCIPLES OF PROGRAMMING LANGUAGES	PEC	2	0	2	3

Course Objectives:

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To develop programs in non-procedural programming paradigms

UNIT – I	**SYNTAX AND SEMANTICS**	**6**
Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom up parsing		
UNIT – II	**DATA, DATA TYPES, AND BASIC STATEMENTS**	**6**
Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection – primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control structures – selection – iterations – branching – guarded statements		
UNIT – III	**SUBPROGRAMS AND IMPLEMENTATIONS**	**6**
Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping		
UNIT – IV	**OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING**	**6**
Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling		
UNIT – V	**FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES**	**6**
Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages		
	Total Contact Hours :30	

LIST OF EXPERIMENTS:	
1	Develop a problem to solve balancing the symbols using control stuctures in C
2	Develop a problem to solve Euler's method using C

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3	Develop a program to solve Shortest path algorithm using C
4	Develop a java application with an 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 funds. Generate pay slips for the employees with their gross and net salary.
5	Implement exception handling and creation of user defined exceptions.
6	Develop stack and queue data structures using classes and objects in Java
7	Implementing a Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) using Python
8	Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)using Python
9	Implementing programs using Functions. (Factorial, largest number in a list, area of shape)using Python
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Describe syntax and semantics of programming languages
CO2:	Explain data, data types, and basic statements of programming languages
CO3:	Design and implement subprogram constructs
CO4:	Apply object-oriented, concurrency, and event handling programming constructs and Develop programs in Scheme, ML, and Prolog
CO5:	Understand and adopt new programming languages

Textbooks:

1.	Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.
2.	Michael L. Scott, “Programming Language Pragmatics”, Fourth Edition, Elsevier, 2018.
3.	R. Kent Dybvig, “The Scheme programming language”, Fourth Edition, Prentice Hall, 2011.
4.	Jeffrey D. Ullman, “Elements of ML programming”, Second Edition, Pearson, 1997.
5.	W. F. Clocksin and C. S. Mellish, “Programming in Prolog: Using the ISO Standard”, Fifth Edition, Springer, 2003.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	2	3	2	1	-	-	-	-	-	3	2	3	-
CO2:	3	3	3	2	2	-	-	-	-	-	3	2	3	-
CO3:	3	3	3	2	2	-	-	-	-	-	3	2	3	-

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CO4:	3	3	3	3	2	-	-	-	-	-	-	3	2	-
CO5:	3	3	3	3	3	2	2	1	3	1	3	3	3	-
Average:	**2.8**	**2.8**	**3**	**2.4**	**2**	**2**	**2**	**1**	**3**	**1**	**3**	**2.4**	**2.8**	**-**

PROFESSIONAL ELECTIVE COURSES:VERTICAL-III

Subject Code	Subject Name	Category	L	T	P	C
CCS2403	**CLOUD COMPUTING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the principles of cloud architecture, models and infrastructure
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT – I	**CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE**	**6**
Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges		
UNIT – II	**VIRTUALIZATION BASICS**	**6**
Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.		
UNIT – III	**VIRTUALIZATION INFRASTRUCTURE AND DOCKER**	**7**
Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.		
UNIT – IV	**CLOUD DEPLOYMENT ENVIRONMENT**	**6**
Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.		
UNIT – V	**CLOUD SECURITY**	**5**
Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.		
	Total Contact Hours :30	

LIST OF EXPERIMENTS

1. Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.

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2. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs.
3. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
4. Use the GAE launcher to launch the web applications.
5. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Install Hadoop single node cluster and run simple applications like wordcount.
8. Creating and Executing Your First Container Using Docker.
9. Run a Container from Docker Hub
Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1	Understand the design challenges in the cloud.
CO2	Apply the concept of virtualization and its types.
CO3	Experiment with virtualization of hardware resources and Docker.
CO4	Develop and deploy services on the cloud and set up a cloud environment.
CO5	Explain security challenges in the cloud environment.

Textbooks:	
1.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010
2.	James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.

Reference Books/Other Materials/WebResources:	
1.	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO110**	**PO111**	**PSO1**	**PSO2**	**PSO3**

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CO1:	3	2	1	1	1	-	-	2	3	1	3	2	1	3
CO2:	3	1	2	2	1	-	-	1	2	1	3	2	2	1
CO3:	2	3	2	3	1	-	-	3	1	1	3	1	1	1
CO4:	1	2	3	3	3	-	-	3	3	1	2	1	3	3
CO5:	2	3	3	1	3	-	-	2	2	1	2	2	2	3
Average:	2.2	2.2	2.2	2	1.8	-	-	2.2	2.2	1	2.6	1.6	1.8	2.2

Subject Code	Subject Name	Category	L	T	P	C
CCS2414	**VIRTUALIZATION**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To Learn the basics and types of Virtualization
- To understand the Hypervisors and its types
- To Explore the Virtualization Solutions
- To Experiment the virtualization platforms

UNIT – I	**INTRODUCTION TO VIRTUALIZATION**	**7**
Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization - Paravirtualization-Types of Hypervisors		
UNIT – II	**SERVER AND DESKTOP VIRTUALIZATION**	**6**
Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization		
UNIT – III	**NETWORK VIRTUALIZATION**	**6**
Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization-VLAN-WAN Architecture-WAN Virtualization		
UNIT – IV	**STORAGE VIRTUALIZATION**	**5**
Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping-Risks of Storage Virtualization-SAN-NAS-RAID		
UNIT – V	**VIRTUALIZATION TOOLS**	**6**
VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study		
	Total Contact Hours :30	

LIST OF EXPERIMENTS

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.

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2. a. Shrink and extend virtual disk b. Create, Manage, Configure and schedule snapshots c. Create Spanned, Mirrored and Striped volume d. Create RAID 5 volume
3. a. Desktop Virtualization using VNC b. Desktop Virtualization using Chrome Remote Desktop
4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Install KVM in Linux
7. Create Nested Virtual Machine(VM under another VM)
Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Analyse the virtualization concepts and Hypervisor
CO2:	Apply the Virtualization for real-world applications
CO3:	Install & Configure the different VM platforms
CO4:	Experiment with the VM with various software

Textbooks:	
1.	Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2.	Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3.	David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4.	Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005
5.	James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
6.	David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO110**	**PO111**	**PSO1**	**PSO2**	**PSO3**
CO1:	1	3	1	3	2	-	-	1	1	3	1	2	3	2
CO2:	3	2	2	1	2	-	-	1	2	2	3	3	2	1
CO3:	3	2	1	3	1	-	-	2	2	1	3	3	3	2

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CO4:	1	1	2	3	3	-	-	3	3	1	1	3	2	2
CO5:	1	3	2	3	1	-	-	2	1	3	3	1	1	2
Average:	1.8	2.2	1.6	2.6	1.8	-	-	1.8	1.8	2	2.2	2.4	2.2	1.8

Subject Code	Subject Name	Category	L	T	P	C
CCS2409	**CLOUD SERVICES MANAGEMENT**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud
- Services
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world Problems

UNIT – I	**CLOUD SERVICE MANAGEMENT FUNDAMENTALS**	**6**
Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models		
UNIT – II	**CLOUD SERVICES STRATEGY**	**6**
Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture		
UNIT – III	**CLOUD SERVICE MANAGEMENT**	**6**
Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management		
UNIT – IV	**CLOUD SERVICE ECONOMICS**	**6**
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models		
UNIT – V	**CLOUD SERVICE GOVERNANCE & VALUE**	**6**
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership		
		Total Contact Hours :30

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LIST OF EXPERIMENTS	
1.Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack, Eucalyptus, OpenNebula with Role-based access control	
2. Create a Cost-model for a web application using various services and do Cost-benefit Analysis	
3. Create alerts for usage of Cloud resources	
4. Create Billing alerts for your Cloud Organization	
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and suggest the best one	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Exhibit cloud-design skills to build and automate business solutions using cloud technologies.
CO2:	Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services
CO3:	Solve the real world problems using Cloud services and technologies

Textbooks:	
1.	Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2.	Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3.	Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

Reference Books/Other Materials/WebResources:	
1.	Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2.	Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO110**	**PO111**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	1	1	1	-	-	2	1	3	2	2	1	3
CO2:	3	1	2	3	2	-	-	1	2	3	1	2	2	2
CO3:	1	1	3	1	3	-	-	3	3	1	1	3	2	1
CO4:	1	1	1	2	3	-	-	2	3	3	1	1	1	1
CO5:	1	3	3	2	2	-	-	1	3	1	2	1	3	2
Average:	1.8	1.8	2	1.8	2.2	-	-	1.8	2.4	2.2	1.4	1.8	1.8	1.8

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Subject Code	Subject Name	Category	L	T	P	C
CCS2415	DATA WAREHOUSING	PEC	2	0	2	3

Course Objectives:

- To know the details of data warehouse Architecture
- To understand the OLAP Technology
- To understand the partitioning strategy
- To differentiate various schema
- To understand the roles of process manager & system manager

UNIT – I	**INTRODUCTION TO DATA WAREHOUSE**	**5**
Data warehouse Introduction - Data warehouse components- operational database Vs data warehouse – Data warehouse Architecture – Three-tier Data Warehouse Architecture - Autonomous Data Warehouse- Autonomous Data Warehouse Vs Snowflake - Modern Data Warehouse.		
UNIT – II	**ETL AND OLAP TECHNOLOGY**	**6**
What is ETL – ETL Vs ELT – Types of Data warehouses - Data warehouse Design and Modeling - Delivery Process - Online Analytical Processing (OLAP) - Characteristics of OLAP - Online Transaction Processing (OLTP) Vs OLAP - OLAP operations- Types of OLAP- ROLAP Vs MOLAP Vs HOLAP.		
UNIT – III	**META DATA, DATA MART AND PARTITION STRATEGY**	**7**
Meta Data – Categories of Metadata – Role of Metadata – Metadata Repository – Challenges for Meta Management - Data Mart – Need of Data Mart- Cost Effective Data Mart- Designing Data Marts- Cost of Data Marts- Partitioning Strategy – Vertical partition – Normalization – Row Splitting – Horizontal Partition.		
UNIT – IV	**DIMENSIONAL MODELING AND SCHEMA**	**6**
Dimensional Modeling- Multi-Dimensional Data Modeling – Data Cube- Star Schema- Snowflake schema- Star Vs Snowflake schema- Fact constellation Schema- Schema Definition - Process Architecture- Types of Data Base Parallelism – Datawarehouse Tools.		
UNIT – V	**SYSTEM & PROCESS MANAGERS**	**6**
Data Warehousing System Managers: System Configuration Manager- System Scheduling Manager - System Event Manager - System Database Manager - System Backup Recovery Manager - Data Warehousing Process Managers: Load Manager – Warehouse Manager- Query Manager – Tuning – Testing.		
	Total Contact Hours :30	

LIST OF EXPERIMENTS

1. Data exploration and integration with WEKA
2. Apply weka tool for data validation
3. Plan the architecture for real time application
4. Write the query for schema definition
5. Design data ware house for real time applications

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6. Analyse the dimensional Modeling	
7. Case study using OLAP	
8. Case study using OTLP	
9. Implementation of warehouse testing.	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Design data warehouse architecture for various Problems
CO2:	Apply the OLAP Technology
CO3:	Analyse the partitioning strategy
CO4:	Critically analyze the differentiation of various schema for given problem
CO5:	Frame roles of process manager & system manager

Text Books:	
1.	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2008.
2.	Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.

Reference Books/Other Materials/WebResources:	
1.	Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2.	K.P. Soman, ShyamDiwakar and V. Ajay "Insight into Data mining Theory and Practice",Easter Economy Edition, Prentice Hall of India, 2006.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO110**	**PO111**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	2	2	-	-	3	-	-	3	3	2	1
CO2:	3	2	2	2	3	-	-	2	-	2	2	3	3	1
CO3:	3	3	3	3	-	-	-	-	-	-	3	3	2	1
CO4:	3	3	3	3	-	-	-	-	-	-	3	3	3	1
CO5:	3	2	2	2	-	2	-	-	-	2	2	2	2	3
Average:	3	2.6	2.6	1.2	2.5	1	-	2.5	-	2	2.6	2.8	2.4	1.4

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2416	**STORAGE TECHNOLOGIES**	**PCC**	**2**	**0**	**2**	**3**

Course Objectives:
• Characterize the functionalities of logical and physical components of storage.
• Describe various storage networking technologies.
• Identify different storage virtualization technologies.
• Discuss the different backup and recovery strategies.

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- Understand common storage management activities and solutions.

UNIT – I	**STORAGE SYSTEMS**	**6**
Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.		
UNIT – II	**INTELLIGENT STORAGE SYSTEMS AND RAID**	**6**
Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale out storage Architecture.		
UNIT – III	**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**	**6**
Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.		
UNIT – IV	**BACKUP, ARCHIVE AND REPLICATION**	**6**
Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).		
UNIT – V	**SECURING STORAGE INFRASTRUCTURE**	**6**
Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.		
		Total Contact Hours : 30

LIST OF EXPERIMENTS	
1. Creation and Management of Basic Storage Partitions and File Systems.	
2. Implement Software RAID Levels and Verification of RAID Functionality.	
3. Configuration of Logical Volume Management (LVM) for Storage Virtualization.	
4. Setup and Testing of iSCSI Target and Initiator for Network-Based Storage.	
5. Execution of Backup and Restore Operations Using Tar, Rsync, and Snapshots.	
6. Implement Storage Security Using Disk Encryption and Access Controls.	
	Total Contact Hours : 30

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Course Outcomes:	After the successful completion of this course, the student will be able to
CO1:	Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
CO2:	Illustrate the usage of advanced intelligent storage systems and RAID
CO3:	Interpret various storage networking architectures - SAN, including storage subsystems and virtualization
CO4:	Examine the different role in providing disaster recovery and remote replication technologies.
CO5:	Infer the security needs and security measures to be employed in information storage management.

Textbooks:	
1.	EMC Corporation, Information Storage and Management, Wiley, India.
2.	Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017.
3.	Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein ,Storage Networks Explained, Second Edition, Wiley, 2009

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1:	1	2	1	3	3	-	-	1	1	1	3	1	2	1
CO2:	3	1	2	3	3	-	-	3	2	3	2	2	3	1
CO3:	1	1	3	2	2	-	-	3	1	1	2	2	3	3
CO4:	3	2	1	2	2	-	-	1	1	3	1	3	2	1
CO5:	1	3	2	1	2	-	-	1	2	3	1	3	2	1
Average:	1.8	1.8	1.8	2.2	2.4	-	-	1.8	1.4	2.2	1.8	2.2	2.4	1.4

Subject Code	Subject Name	Category	L	T	P	C
CCS2417	SOFTWARE DEFINED NETWORKS	PEC	2	0	2	3

Course Objectives:

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

UNIT – I	SDN: INTRODUCTION	6
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane , Control plane and Application Plane		

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UNIT – II	**SDN DATA PLANE AND CONTROL PLANE**	**6**
Data Plane functions and protocols - OpenFLow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers		
UNIT – III	**SDN APPLICATIONS**	**6**
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking		
UNIT – IV	**NETWORK FUNCTION VIRTUALIZATION**	**6**
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture		
UNIT – V	**NFV FUNCTIONALITY**	**6**
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV		
	Total Contact Hours :30	

LIST OF EXPERIMENTS	
1.Setup your own virtual SDN lab i) Virtualbox/Mininet Environment for SDN - http://mininet.org ii) https://www.kathara.org iii) GNS3	
2.Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.	
3. Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.	
4.Create a simple end-to-end network service with two VNFs using vim-emu	
5. Install OSM and onboard and orchestrate network service.	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Describe the motivation behind SDN
CO2:	Identify the functions of the data plane and control plane
CO3:	Design and develop network applications using SDN
CO4:	Orchestrate network services using NFV
CO5:	Explain various use cases of SDN and NFV

Textbooks:	
1.	William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.

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Reference Books/Other Materials/WebResources:	
1.	Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2.	Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3.	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4.	Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
5.	Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	1	2	3	1	3	-	-	2	3	1	3	1	2	1
CO2:	2	1	2	2	3	-	-	2	2	2	2	1	3	2
CO3:	2	2	2	3	3	-	-	3	1	1	2	1	3	3
CO4:	2	2	2	3	1	-	-	1	3	1	2	2	2	2
CO5:	3	3	1	1	3	-	-	1	2	1	2	2	1	3
Average:	2	2	2	2	2.6	-	-	1.8	2.2	1.2	2.2	1.4	2.2	2.2

Subject Code	Subject Name	Category	L	T	P	C
CCS2418	**SECURITY AND PRIVACY IN CLOUD**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

UNIT – I	**FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**	**7**
Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Non repudiation,Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.		
UNIT – II	**SECURITY DESIGN AND ARCHITECTURE FOR CLOUD**	**6**
Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.		
UNIT – III	**ACCESS CONTROL AND IDENTITY MANAGEMENT**	**6**

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Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.		
UNIT – IV	**CLOUD SECURITY DESIGN PATTERNS**	**6**
Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.		
UNIT – V	**MONITORING, AUDITING AND MANAGEMENT**	**5**
Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.		
		Total Contact Hours :30

LIST OF EXPERIMENTS	
1. Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm not present in Cloud Sim	
2. Simulate resource management using cloud sim	
3. Simulate log forensics using cloud sim	
4. Simulate a secure file sharing using a cloud sim	
5. Implement data anonymization techniques over the simple dataset (masking, kanonymization, etc)	
6. Implement any encryption algorithm to protect the images	
7. Implement any image obfuscation mechanism	
8. Implement a role-based access control mechanism in a specific scenario	
9. Implement an attribute-based access control mechanism based on a particular scenario	
10. Develop a log monitoring system with incident management in the cloud	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the cloud concepts and fundamentals.
CO2:	Explain the security challenges in the cloud.
CO3:	Define cloud policy and Identity and Access Management
CO4:	Understand various risks and audit and monitoring mechanisms in the cloud.
CO5:	Define the various architectural and design considerations for security in the cloud.

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Textbooks:	
1.	Raj Kumar Buyya , James Broberg, andrzejGoscinski, “Cloud Computing:‖, Wiley 2013
2.	Dave shackleford, “Virtualization Security‖, SYBEX a wiley Brand 2013.
3.	Mather, Kumaraswamy and Latif, “Cloud Security and Privacy‖, OREILLY 2011

Reference Books/Other Materials/Web Resources:	
1.	Mark C. Chu-Carroll “Code in the Cloud‖,CRC Press, 2011.
2.	Mastering Cloud Computing Foundations and Applications Programming RajkumarBuyya, Christian Vechhiola, S. ThamaraiSelvi

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	1	2	-	-	1	1	1	3	3	1	2
CO2:	1	3	2	3	1	-	-	2	2	3	2	3	1	2
CO3:	3	2	2	3	2	-	-	3	1	1	2	2	3	1
CO4:	2	1	2	3	3	-	-	3	2	3	3	1	1	2
CO5:	1	3	3	1	1	-	-	2	3	3	2	2	3	2
Average:	2	2.4	2.4	2.2	1.8	-	-	2.2	1.8	2.2	2.4	2.2	1.8	1.8

PROFESSIONAL ELECTIVE COURSES:VERTICAL-IV

Subject Code	Subject Name	Category	L	T	P	C
CCS2419	**ETHICAL HACKING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the basics of computer based vulnerabilities.
- To explore different foot printing, reconnaissance and scanning methods
- To expose the enumeration and vulnerability analysis methods.
- To understand hacking options available in Web and wireless applications.
- To explore the options for network protection.
- To practice tools to perform ethical hacking to expose the vulnerabilities.

UNIT – I	INTRODUCTION	6
Ethical Hacking Overview - Role of Security and Penetration Testers .- Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing .- Network and Computer Attacks - Malware - Protecting Against Malware Attacks.- Intruder Attacks - Addressing Physical Security		
UNIT – II	**FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS**	**6**

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Foot printing Concepts – Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence – Foot printing through Social Engineering - Foot printing Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall		
UNIT – III	**ENUMERATION AND VULNERABILITY ANALYSIS**	**6**
Enumeration Concepts - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded Oss		
UNIT – IV	**SYSTEM HACKING**	**6**
Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Ward riving- Wireless Hacking - Tools of the Trade		
UNIT – V	**NETWORK PROTECTION SYSTEMS**	**6**
Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams – Honey pots.		
		Total Contact Hours :30

LIST OF EXPERIMENTS
1. Install Kali or Backtrack Linux / Metasploitable/ Windows XP
2. Practice the basics of reconnaissance.
3. Using FOCA / SearchDiggity tools, extract metadata and expanding the target list.
4. Aggregates information from public databases using online free tools like Paterva's Maltego.
5. Information gathering using tools like Robtex.
6. Scan the target using tools like Nessus.
7. View and capture network traffic using Wireshark.
8. Automate dig for vulnerabilities and match exploits using Armitage
FOCA : http://www.informatica64.com/foca.aspx. Nessus : http://www.tenable.com/products/nessus. Wireshark : http://www.wireshark.org. Armitage : http://www.fastandeasyhacking.com/. Kali or Backtrack Linux, Metasploitable, Windows XP
Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	To express knowledge on basics of computer based vulnerabilities
CO2:	To gain understanding on different foot printing, reconnaissance and scanning methods.

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CO3:	To demonstrate the enumeration and vulnerability analysis methods
CO4:	To gain knowledge on hacking options available in Web and wireless applications.
CO5:	To acquire knowledge on the options for network protection.
CO6:	To use tools to perform ethical hacking to expose the vulnerabilities.

Textbooks:	
1.	Michael T. Simpson, Kent Backman, and James E. Corley, Hands-On Ethical Hacking and Network Defense, Course Technology, Delmar Cengage Learning, 2010.
2.	The Basics of Hacking and Penetration Testing - Patrick Engebretson, SYNGRESS, Elsevier, 2013.
3.	The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws, Dafydd Stuttard and Marcus Pinto, 2011.

Reference Books/Other Materials/Web Resources:	
1.	Black Hat Python: Python Programming for Hackers and Pentesters, Justin Seitz , 2014.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	2	3	2	1	-	-	1	2	2	1	1	2	3
CO2:	1	2	1	2	1	-	-	2	2	1	1	1	2	2
CO3:	2	2	3	3	1	-	-	1	2	1	2	2	3	1
CO4:	2	1	1	2	1	-	-	1	3	3	3	3	2	1
CO5:	2	3	1	1	2	-	-	2	1	1	1	1	1	3
Average:	1.8	2	1.8	2	1.2	-	-	1.4	2	1.6	1.6	1.6	2	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2420	**DIGITAL AND MOBILE FORENSICS**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation
- To understand how to be prepared for digital forensic readiness
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

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UNIT – I	INTRODUCTION TO DIGITAL FORENSICS	6
Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase		
UNIT – II	**DIGITAL CRIME AND INVESTIGATION**	**6**
Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence		
UNIT – III	**DIGITAL FORENSIC READINESS**	**6**
Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics		
UNIT – IV	**iOS FORENSICS**	**6**
Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud		
UNIT – V	**ANDROID FORENSICS**	**6**
Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling		
		Total Contact Hours :30

LIST OF EXPERIMENTS
1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.
2. Data extraction from call logs using Sleuth Kit.
3. Data extraction from SMS and contacts using Sleuth Kit.
4. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
5. Process and parse records from the iOS system.
6. Extract installed applications from Android devices.
7. Extract diagnostic information from Android devices through the adb protocol.
8. Generate a unified chronological timeline of extracted records.
Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Have knowledge on digital forensics
CO2:	Know about digital crime and investigations.
CO3:	Be forensic ready
CO4:	Investigate, identify and extract digital evidence from iOS devices

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CO5:	Investigate, identify and extract digital evidence from Android devices

Textbooks:	
1.	Andre Arnes, "Digital Forensics", Wiley, 2018.
2.	Chuck Easttom, "An In-depth Guide to Mobile Device Forensics", First Edition, CRC Press, 2022.

Reference Books/Other Materials/Web Resources:	
1.	Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	3	2	1	-	-	1	1	3	3	1	3	1
CO2:	3	3	3	3	3	-	-	2	2	1	2	1	3	1
CO3:	3	3	2	3	1	-	-	3	2	1	1	3	2	3
CO4:	3	1	2	2	3	-	-	1	3	3	2	1	3	3
CO5:	1	3	2	3	2	-	-	2	3	2	3	1	2	1
Average:	3	2	2	3	2	-	-	2	2	2	2	1	3	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2421	**SOCIAL NETWORK SECURITY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To develop semantic web related simple applications
- To explain Privacy and Security issues in Social Networking
- To explain the data extraction and mining of social networks
- To discuss the prediction of human behaviour in social communities
- To describe the Access Control, Privacy and Security management of social networks

UNIT – I	**FUNDAMENTALS OF SOCIAL NETWORKING**	**6**
Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security		
UNIT – II	**SECURITY ISSUES IN SOCIAL NETWORKS**	**6**
The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviours, Anonymity in a networked world		
UNIT – III	**EXTRACTION AND MINING IN SOCIAL NETWORKING DATA**	**6**

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Extracting evolution of Web Community from a Series of Web Archive, Detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy		
UNIT – IV	**PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES**	**6**
Understanding and predicting human behaviour for social communities, User data Management, Inference and Distribution, Enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, Trust in online environment, What is Neo4j, Nodes, Relationships, Properties.		
UNIT – V	**ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT**	**6**
Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning		
	Total Contact Hours :30	

LIST OF EXPERIMENTS	
1. Design own social media application	
2. Create a Network model using Neo4j	
3. Read and write Data from Graph Database	
4. Find "Friend of Friends" using Neo4j	
5. Implement secure search in social media	
6. Create a simple Security & Privacy detector	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Develop semantic web related simple applications
CO2:	Address Privacy and Security issues in Social Networking
CO3:	Explain the data extraction and mining of social networks
CO4:	Discuss the prediction of human behaviour in social communities
CO5:	Describe the applications of social networks

Textbooks:	
1.	Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007
2.	BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer, 2010.

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3	Learning Neo4j 3.x Second Edition By Jérôme Baton, Rik Van Bruggen, Packt publishing
4	David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a Highly Connected World‖, First Edition, Cambridge University Press, 2010.

Reference Books/Other Materials/Web Resources:	
1.	Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly Connected World‖, Cambridge University Press, 2010.
2.	Jackson, Matthew O., Social and Economic Networks‖, Princeton University Press, 2008.
3.	GuandongXu ,Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications‖, First Edition, Springer, 2011.
4	Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively‖, IGI Global Snippet, 2008.
5	Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modeling‖, IGI Global Snippet, 2009.
6	John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web‖, Springer, 2009.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	2	3	2	-	-	3	2	1	2	3	3	2
CO2:	2	2	2	3	3	-	-	1	2	2	3	3	3	2
CO3:	2	1	1	3	2	-	-	1	2	1	1	1	3	3
CO4:	3	3	3	3	2	-	-	1	1	1	1	2	1	3
CO5:	1	3	2	2	2	-	-	1	1	3	1	2	3	3
Average:	2.2	2	2	2.8	2.2	-	-	1.4	1.6	1.6	1.6	2.2	2.6	2.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2422	**Modern Cryptography**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To learn about Modern Cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudo random permutation.
- To construct Basic cryptanalytic techniques.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT – I	**INTRODUCTION**	**6**
Basics of Symmetric Key Cryptography, Basics of Asymmetric Key Cryptography, Hardness of Functions. Notions of Semantic Security (SS) and Message In distinguish ability (MI): Proof of Equivalence of SS and MI, Hard Core Predicate, Trap-door permutation, Gold was ser-Micali		

Encryption. Gold reich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.		
UNIT – II	**FORMAL NOTIONS OF ATTACKS**	**6**
Attacks under Message In distinguish ability: Chosen Plaintext Attack (IND-CPA), Chosen Cipher text Attacks (IND-CCA1 and IND-CCA2), Attacks under Message Non-malleability: NM-CPA and NM-CCA2, Inter-relations among the attack model .		
UNIT – III	**RANDOM ORACLES**	**6**
Provable Security and asymmetric cryptography, hash functions. One-way functions: Weak and Strong one-way functions. Pseudo-random Generators (PRG): Blum-Micali-Yao Construction, Construction of more powerful PRG, Relation between One-way functions and PRG, Pseudorandom Functions (PRF) .		
UNIT – IV	**BUILDING A PSEUDORANDOM PERMUTATION**	**6**
The Luby Rack off Construction: Formal Definition, Application of the Luby Rack off Construction to the construction of Block Ciphers, The DES in the light of Luby Rack off Construction.		
UNIT – V	**MESSAGE AUTHENTICATION CODES**	**6**
Left or Right Security (LOR). Formal Definition of Weak and Strong MACs, Using a PRF as a MAC, Variable length MAC. Public Key Signature Schemes: Formal Definitions, Signing and Verification, Formal Proofs of Security of Full Domain Hashing. Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures. Shamir's Secret Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs and Protocols.		
	Total Contact Hours :30	

LIST OF EXPERIMENTS	
1. Implement Feige-Fiat-Shamir identification protocol.	
2. Implement GQ identification protocol.	
3. Implement Schnorr identification protocol.	
4. Implement Rabi none-time signature scheme.	
5. Implement Merkle one-time signature scheme.	
6. Implement Authentication trees and one-time signatures.	
7. Implement GMR one-time signature scheme.	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Interpret the basic principles of cryptography and general cryptanalysis.
CO2:	Determine the concepts of symmetric encryption and authentication.

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CO3:	Identify the use of public key encryption, digital signatures, and key establishment.
CO4:	Articulate the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
CO5:	Express the use of Message Authentication Codes.

Textbooks:	
1.	Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag.
2.	Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition)

Reference Books / Other Materials/ Web Resources:	
1.	1. Shaffi Gold wasser and Mihir Bellare, Lecture Notes on Cryptography, Available at http://citeseerx.ist.psu.edu/.
2.	2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), Part 1 and Part 23
3.	3. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 3rd Edition, 2006.

	CO-PO Mapping												**CO-PSO Mapping**	
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	1	-	2	1	1	2	2	2	1	1
CO2:	1	3	2	1	2	-	3	2	2	2	3	2	1	3
CO3:	1	1	2	3	2	-	1	1	1	3	1	1	1	3
CO4:	3	1	2	1	3	-	3	2	1	2	3	3	2	1
CO5:	2	3	3	3	3	-	3	1	1	1	3	2	1	1
Average:	2	2.2	2.4	2.2	2.2	-	2.4	1.4	1.2	2	2.4	2	1.2	1.8

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2440	**Malware Analysis**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To introduce the fundamentals of malware, types and its effects
- To enable to identify and analyse various malware types by static analysis
- To enable to identify and analyse various malware types by dynamic analysis
- To construct Basic cryptanalytic techniques.
- To deal with detection, analysis, understanding, controlling, and eradication of malware

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UNIT – I	**INTRODUCTION AND BASIC ANALYSIS**	**6**
Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.		
UNIT – II	**ADVANCED STATIC ANALYSIS**	**7**
The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.		
UNIT – III	**ADVANCED DYNAMIC ANALYSIS**	**7**
Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, api calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching		
UNIT – IV	**MALWARE FUNCTIONALITY**	**5**
Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching-Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.		
UNIT – V	**ANDROID MALWARE ANALYSIS**	5
Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies.		
		Total Contact Hours :30

LIST OF EXPERIMENTS
1. Experimentation on Initial Infection Vectors and Malware Discovery
2. Implementation on Sandboxing Malware and Gathering Information From Runtime Analysis
3. Implementation on Portable Executable (PE32) File Format.
4. Implementation on Executable Metadata and Executable Packers
5. Experimentation on Malware Self - Defense, Compression, and Obfuscation Techniques

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6. Experimentation on Malware behaviour analysis
7. Experimentation on analyzing Malicious Microsoft Office and Adobe PDF Documents
8. Experimentation on Mobile malware analysis
9. Experimentation on Packing and Unpacking of malware
10. Experimentation on Root kit Anti Forensics and Covert Channels
11. Experimentation on Modern Root kit Analysis
12. Experimentation on Malware traffic analysis
Implement of real time applications for the following malware analysis
Implement of real time applications for the following malware analysis
Dynamic analysis of malwares.
Classification of malwares based on their behavior.
Usage of tools to classify malware
Advanced malware analysis
Android malware analysis
Applying antivirus tools in various applications
Malware report documentation
Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the various concepts of malware analysis and their technologies used.
CO2:	Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques
CO3:	Understandthemethodsandtechniquesusedbyprofessionalmalwareanalysts
CO4:	To be able to safely analyze, debug, and is assemble any malicious software by malware analysis
CO5:	Understand the concept of Android malware analysis their architecture ,and App development

Textbooks:	
1.	Michael Sikorski and Andrew Honig, "Practical Malware Analysis" by No Starch Press, 2012,ISBN: 9781593272906
2.	Bill Blunden, "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System", Second Edition,Jones & Bartlett Publishers, 2009.

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Reference Books / Other Materials/ Web Resources:	
1.	Jamie Butler and GregHoglund,“Rootkits:Subverting the Windows Kernel”by2005, Addison-Wesley Professional
2.	Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
3.	VictorMarak,"WindowsMalwareAnalysisEssentials"PacktPublishing,O’Reilly,2015.
4	Ken Dunham, Shane Hartman, ManuQuintans, Jose Andre Morales, TimStrazzere," Android Malware and Analysis",CRC Press, Taylor & Francis Group, 2015.
5	Windows Malware Analysis Essentials by Victor Marak, Packt Publishing,2015.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	2	1	1	1	-	1	1	-	-	1	-	2	2	1
CO2:	1	3	1	3	2	1	-	-	-	-	-	2	2	-
CO3:	1	1	1	1	-	1	-	-	-	1	-	2	2	-
CO4:	2	3	2	2	2	1	-	-	-	-	-	2	2	-
CO5:	2	2	1	1	1	1	1	-	-	1	-	2	2	1
Average:	1.6	2	1.2	1.6	1	1	0.4	0	0	0.6	0	2	2	0.4

Subject Code	Subject Name	Category	L	T	P	C
CCS2433	**QUANTUM COMPUTING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

UNIT – I	**QUANTUM COMPUTING BASIC CONCEPTS**	**6**
Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions		
UNIT – II	**QUANTUM GATES AND CIRCUITS**	**5**
Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction.		

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UNIT – III	**QUANTUM ALGORITHMS**	**7**
Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm		
UNIT – IV	**QUANTUM INFORMATION THEORY**	**6**
Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels		
UNIT – V	**QUANTUM CRYPTOGRAPHY**	**6**
Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91		
		Total Contact Hours :30

LIST OF EXPERIMENTS	
1. Single qubit gate simulation - Quantum Composer	
2. Multiple qubit gate simulation - Quantum Composer	
3. Composing simple quantum circuits with q-gates and measuring the output into classical bits.	
4. IBM Qiskit Platform Introduction	
5. Implementation of Shor's Algorithms	
6. Implementation of Grover's Algorithm	
7. Implementation of Deutsch's Algorithm	
8. Implementation of Deutsch-Jozsa's Algorithm	
9. Integer factorization using Shor's Algorithm	
10. QKD Simulation	
11. Mini Project such as implementing an API for efficient search using Grover's Algorithms	
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the basics of quantum computing.
CO2:	Understand the background of Quantum Mechanics.
CO3:	Analyze the computation models.
CO4:	Model the circuits using quantum computation. environments and frameworks.
CO5:	Understand the quantum operations such as noise and error–correction.

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Textbooks:	
1.	Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2.	Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3.	Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".

Reference Books/Other Materials/WebResources:	
1.	Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2.	N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	-	-	-	-	2	-	-	2	3	2
CO2	3	2	2	2	-	-	-	-	2	-	-	2	3	1
CO3	3	3	3	3	2	-	-	-	3	-	-	3	2	2
CO4	3	3	3	3	3	-	-	-	3	-	-	1	3	2
CO5	3	3	2	3	-	-	-	-	2	-	-	1	3	3
Average:	3	2.6	2.4	2.6	1	-	-	-	2.4	-	-	1.8	2.8	2

Subject Code	Subject Name	Category	L	T	P	C
CCS2446	**NETWORK SECURITY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To learn the fundamentals of cryptography.
- To learn the key management techniques and authentication approaches.
- To explore the network and transport layer security techniques.
- To understand the application layer security standards.
- To learn the real time security practices.

UNIT – I	**INTRODUCTION**	**8**
Basics of cryptography, conventional and public-key cryptography, hash functions, authentication, and digital signatures.		
UNIT – II	**KEY MANAGEMENT AND AUTHENTICATION**	**7**

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Key Management and Distribution: Symmetric Key Distribution, Distribution of Public Keys, X.509 Certificates, Public-Key Infrastructure. User Authentication: Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos Systems, Remote User Authentication Using Asymmetric Encryption.		
UNIT – III	**ACCESS CONTROL AND SECURITY**	**4**
Network Access Control: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control - IP Security - Internet Key Exchange (IKE). Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application.		
UNIT – IV	**APPLICATION LAYER SECURITY**	**5**
Electronic Mail Security: Pretty Good Privacy, S/MIME, Domain Keys Identified Mail. Wireless Network Security: Mobile Device Security.		
UNIT – V	**SECURITY PRACTICES**	**6**
Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations. Blockchains, Cloud Security and IoT security.		
		Total Contact Hours: 30

LIST OF EXPERIMENTS	
1. Implement symmetric key algorithms	
2. Implement asymmetric key algorithms and key exchange algorithms	
3. Implement digital signature schemes	
4. Installation of Wire shark, tcpdump and observe data transferred in client-server communication using UDP/TCP and identify the UDP/TCP datagram.	
5. Check message integrity and confidentiality using SSL	
6. Experiment Eavesdropping, Dictionary attacks, MITM attacks	
7. Experiment with Sniff Traffic using ARP Poisoning	
8. Demonstrate intrusion detection system using any tool.	
9. Explore network monitoring tools	
10. Study to configure Firewall, VPN	
	Total Contact Hours: 30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Classify the encryption techniques

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CO2:	Illustrate the key management technique and authentication.
CO3:	Evaluate the security techniques applied to network and transport layer
CO4:	Discuss the application layer security standards.
CO5:	Apply security practices for real time applications.

Textbooks:	
1.	Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.

Reference Books/Other Materials/Web Resources:	
1.	Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.
2.	Linux iptables Pocket Reference, Gregor N. Purdy, O'Reilly, 2004, ISBN-13: 978-0596005696.
3.	Linux Firewalls, by Michael Rash, No Starch Press, October 2007, ISBN: 978-1-59327-141-1.
4.	Network Security, Firewalls And VPNs, J. Michael Stewart, Jones & Bartlett Learning, 2013, ISBN-10: 1284031675, ISBN-13: 978-1284031676.
5.	The Network Security Test Lab: A Step-By-Step Guide, Michael Gregg, Dreamtech Press, 2015, ISBN-10:8126558148, ISBN-13: 978-8126558148.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	2	2	-	-	2	1	2	1	2	3	1
CO2:	1	1	3	2	2	-	-	2	2	1	1	3	1	2
CO3:	1	2	1	1	2	-	-	3	3	1	3	2	1	3
CO4;	2	2	3	2	3	-	-	3	3	2	1	2	1	3
CO5;	2	1	3	2	2	-	-	2	1	1	3	2	1	1
Average:	1.8	1.8	2.4	1.8	2.2	-	-	2.4	2	1.4	1.8	2.2	1.4	2

PROFESSIONAL ELECTIVE COURSES:VERTICAL-V

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2425	**MULTIMEDIA AND ANIMATION**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To grasp the fundamental knowledge of Multimedia elements and systems.
- To get familiar with Multimedia file formats and standards.
- To learn the process of authoring multimedia presentations.
- To learn the techniques of animation in 2D and 3D and for the mobile UI.
- To explore different popular applications of multimedia.

UNIT – I	**INTRODUCTION TO MULTIMEDIA**	**6**
Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems,		

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challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.		
UNIT – II	**MULTIMEDIA FILE FORMATS AND STANDARDS**	**6**
File formats – Text, Image file formats, Graphic and animation file formats, Digital audio and Video file formats, Color in image and video, Color Models. Multimedia data and file formats for the web.		
UNIT – III	**MULTIMEDIA AUTHORING**	**6**
Authoring metaphors, Tools Features and Types: Card and Page Based Tools, Icon and Object Based Tools, Time Based Tools, Cross Platform Authoring Tools, Editing Tools, Painting and Drawing Tools, 3D Modeling and Animation Tools, Image Editing Tools, audio Editing Tools, Digital Movie Tools, Creating interactive presentations, virtual learning, simulations.		
UNIT – IV	**ANIMATION**	**6**
Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Key frame, Morphing, Inverse Kinematics, Hand Drawn, Character rigging, vector animation, stop motion, motion graphics, , Fluid Simulation, skeletal animation, skinning Virtual Reality, Augmented Reality.		
UNIT – V	**MULTIMEDIA APPLICATIONS**	**6**
Multimedia Big data computing, social networks, smart phones, surveillance, Analytics, Multimedia Cloud Computing, Multimedia streaming cloud, media on demand, security and forensics, Online social networking, multimedia ontology, Content based retrieval from digital libraries.		
		Total Contact Hours :30

LIST OF EXPERIMENTS	
1.	Working with Image Editing tools: Install tools like GIMP/ InkScape / Krita / Pencil and perform editing operations: • Use different selection and transform tools to modify or improve an image. • Create logos and banners for home pages of websites.
2.	Working with Audio Editing tools: • Install tools like, Audacity / Ardour for audio editing, sound mixing and special effects like fade-in or fade-out etc., • Perform audio compression by choosing a proper codec.
3.	Working with Video Editing and conversion tools: Install tools like OpenShot / Cinelerra / HandBrake for editing video content. • Edit and mix video content, remove noise, create special effects, add captions. • Compress and convert video file format to other popular formats.
4.	Working with web/mobile authoring tools: Adapt / KompoZer/ BlueGriffon / BlueFish / Aptana Studio/ NetBeans /WordPress /Expression Web: • Design simple Home page with banners, logos, tables quick links etc., • Provide a search interface and simple navigation from the home page to the inside

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	pages of the website. • Design Responsive web pages for use on both web and mobile interfaces.
5.	Working with Animation tools: Install tools like, Krita, Wick Editor, Blender: • Perform a simple 2D animation with sprites. • Perform simple 3D animation with keyframes, kinematics.
6.	Working with Mobile UI animation tools: Origami studio / Lottie / Framer etc.,
7.	Working with E-Learning authoring tools: Install tools like EdApp / Moovly / CourseLab/ IsEazy and CamStudio/Ampache, VideoLAN: • Demonstrate screen recording and further editing for e-learning content. • Create a simple E-Learning module for a topic of your choice.
8.	Creating VR and AR applications: • Any affordable VR viewer like Google Cardboard and any development platform like Openspace 3D / ARCore etc. Note: all tools listed are open source. Usage of any proprietary tools in place of open source tools is not restricted.
	Total Contact Hours :30

Course Outcomes:	Upon completion of the course, students should be able to:
CO1:	Get the bigger picture of the context of Multimedia and its applications.
CO2:	Use the different types of media elements of different formats on content pages.
CO3:	Author 2D and 3D creative and interactive presentations for different target multimedia applications.
CO4:	Use different standard animation techniques for 2D, 21/2 D, 3D applications.
CO5:	Understand the complexity of multimedia applications in the context of cloud, security, bigdata streaming, social networking, CBIR etc.,

Text Books:	
1.	Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia", Third Edition, Springer Texts in Computer Science, 2021. (UNIT-I, II, III).

Reference Books / Other Materials/ Web Resources:	
1.	John M Blain, The Complete Guide to Blender Graphics: Computer Modeling & Animation, CRC press, 3rd Edition, 2016.
2.	Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press,

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	2018.
3.	PrabhatK.Andleigh, KiranThakrar, "Multimedia System Design", Pearson Education, 1 st Edition, 2015.
4.	Mohsen AminiSalehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
5.	Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
6.	Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles River Media, 2006.
7.	Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3 rd Edition, 2012.
8.	Emilio Rodriguez Martinez, MireiaAlegre Ruiz, "UI Animations with Lottie and After Effects: Create, render, and ship stunning After Effects animations natively on mobile with React Native", Packt Publishing, 2022.
9.	https://itsfoss.com/
10	https://opensource.com/article/18/2/open-source-audio-visual-production-tools https://camstudio.org/
11.	https://developer.android.com/training/animation/overview
12.	https://developer.android.com/training/animation/overview (UNIT-IV)

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	2	3	-	-	3	2	1	2	3	2	3
CO2:	3	3	3	3	3	-	-	3	3	2	2	3	2	3
CO3:	3	3	3	3	3	-	-	3	3	2	3	3	2	3
CO4:	3	3	3	3	3	2	-	3	3	3	3	3	3	3
CO5:	3	3	3	3	3	2	-	3	3	3	3	3	3	3
Average	3.00	2.80	3.00	2.80	3.00	2.00	-	3.00	2.80	2.20	2.60	3.00	2.40	3.00

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2426	**VIDEO CREATION AND EDITING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

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UNIT – I	**FUNDAMENTALS**	**6**
Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.		
UNIT – II	**STORYTELLING**	**6**
Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.		
UNIT – III	**USING AUDIO AND VIDEO**	**6**
Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.		
UNIT – IV	**WORKING WITH FINAL CUT PRO**	**6**
Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.		
UNIT – V	**WORKING WITH AVID XPRESS DV 4**	**6**
Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.		
	Total Contact Hours :30	

LISTOF EXPERIMENTS
1. Write a Movie Synopsis (Individual/Team Writing).
2. Present team stories in class.
3. Script/Storyboard Writing (Individual Assignment).
4. Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts & agreements.
5. Production: Single camera production personnel & equipment, Documentary Production.
6. Writing The Final Proposal: Overview, Media Treatments, Summary, Pitching.
7. Write Documentary & Animation Treatment.
8. Post-production: Editing, Sound design, Finishing.
Total Contact Hours :30

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Course Outcomes	Upon completion of the course students should be able to:
CO1:	Compare the strengths and limitations of Nonlinear editing.
CO2:	Identify the infrastructure and significance of storytelling.
CO3:	Apply suitable methods for recording to CDs and VCDs.
CO4:	Address the core issues of advanced editing and training techniques.
CO5:	Design and develop projects using AVID XPRESS DV 4.

Textbooks:	
1.	Avid Xpress DV 4 User Guide, 2007.
2.	Final Cut Pro 6 User Manual, 2004.
3.	Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
4.	Robert M. Goodman and PartickMcGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	2	1	1	-	-	1	2	3	2	3	1	1
CO2:	2	3	3	3	1	-	-	1	2	2	1	1	1	1
CO3:	2	2	3	3	1	-	-	3	1	1	1	2	1	2
CO4:	2	2	2	2	1	-	-	3	1	1	1	2	2	2
CO5:	2	1	3	3	1	-	-	3	2	1	2	2	2	1
Average	2.2	1.8	2.6	2.4	1	-	-	2.2	1.6	1.6	1.4	2	1.4	1.4

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2439	**GAME THEORY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in 41odeIIing applications.
- To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.
- To introduce contemporary topics in the intersection of game theory, computer science, and economics.
- To apply game theory in searching, auctioning and trading.

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UNIT – I	INTRODUCTION	6
Introduction - Making rational choices: basics of Games - strategy - preferences - payoffs - Mathematical basics - Game theory - Rational Choice - Basic solution concepts - non-cooperative versus cooperative games - Basic computational issues - finding equilibria and learning in games -Typical application areas for game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).		
UNIT – II	**GAMES WITH PERFECT INFORMATION**	**6**
Games with Perfect Information - Strategic games - prisoner's dilemma, matching pennies - Nash equilibria - mixed strategy equilibrium - zero-sum games.		
UNIT – III	**GAMES WITH IMPERFECT INFORMATION**	**6**
Games with Imperfect Information - Bayesian Games - Motivational Examples - General Definitions - Information aspects - Illustrations - Extensive Games with Imperfect - Information - Strategies - Nash Equilibrium - Repeated Games - The Prisoner's Dilemma - Bargaining.		
UNIT – IV	**NON-COOPERATIVE GAME THEORY**	**6**
Non-cooperative Game Theory - Self-interested agents - Games in normal form - Analyzing games: from optimality to equilibrium - Computing Solution Concepts of Normal - Form Games - Computing Nash equilibria of two-player, zero-sum games - Computing Nash equilibria of two-player, general- sum games - Identifying dominated strategies.		
UNIT – V	**MECHANISM DESIGN**	**6**
Aggregating Preferences - Social Choice - Formal Model -Voting - Existence of social functions - Ranking systems - Protocols for Strategic Agents: Mechanism Design - Mechanism design with unrestricted preferences.		
	Total Contact Hours : 30	

LISTOF EXPERIMENTS
1. Prisoner’s dilemma.
2. Pure Strategy Nash Equilibrium.
3. Extensive Form - Graphs and Trees, Game Trees.
4. Strategic Form - Elimination of dominant strategy.
5. Minimax theorem, Minimax strategies.
6. Perfect information games: trees, players assigned to nodes, payoffs, backward Induction, subgame perfect equilibrium.
7. Imperfect-information games - Mixed Strategy Nash Equilibrium - Finding mixed-strategy Nash equilibria for zero sum games, mixed versus behavioral strategies.
8. Repeated Games.
9. Bayesian Nash equilibrium.
Total Contact Hours :30

Course Outcomes	Upon completion the course students should be able to:
CO1:	Discuss the notion of a strategic game and equilibria and identify the

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	characteristics of main applications of these concepts.
CO2:	Discuss the use of Nash Equilibrium for other problems.
CO3:	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation.
CO4:	Identify some applications that need aspects of Bayesian Games.
CO5:	Implement a typical Virtual Business scenario using Game theory.

Textbooks:	
1.	M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2.	M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013
3.	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory. Cambridge University Press, 2007.
4.	A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004
5.	YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge University Press 2008.
6.	Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012.
7.	Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific
8.	William Spaniel, "Game Theory 101: The Complete Textbook", CreateSpace Independent Publishing, 2011.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	3	3	-	-	-	-	-	-	1	1	3
CO2:	3	3	3	2	3	-	-	-	-	-	-	1	1	1
CO3:	1	1	3	3	3	-	-	-	-	-	-	1	1	2
CO4:	2	1	1	1	1	-	-	-	-	-	-	1	1	2
CO5:	2	2	3	2	1	-	-	-	-	-	-	1	1	2
Average	2.2	2	2.4	2.2	2.2	-	-	-	-	-	-	1	1	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2427	**DIGITAL MARKETING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

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UNIT – I	**INTRODUCTION TO ONLINE MARKET**	**6**
Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.		
UNIT – II	**SEARCH ENGINE OPTIMISATION**	**6**
Search Engine optimization - Keyword Strategy - SEO Strategy - SEO success factors - On-Page Techniques - Off-Page Techniques. Search Engine Marketing - How Search Engine works - SEM components - PPC advertising - Display Advertisement.		
UNIT – III	**E- MAIL MARKETING**	**6**
E- Mail Marketing - Types of E - Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile - Measuring and maximizing email campaign effectiveness. Mobile Marketing - Mobile Inventory/channels - Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns - Profiling and targeting.		
UNIT – IV	**SOCIAL MEDIA MARKETING**	**6**
Social Media Marketing - Social Media Channels - Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing - Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.		
UNIT – V	**DIGITAL TRANSFORMATION**	**6**
Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.		
		Total Contact Hours : 30

LISTOF EXPERIMENTS
1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.
3. Demonstrate how to use the Google WebMasters Indexing API
4. Discuss an interesting case study regarding how an insurance company manages leads.
5. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
6. Discuss how Predictive analytics is impacting marketing automation.
Total Contact Hours : 30

Course Outcomes	Upon completion the course students should be able to:
CO1:	To examine and explore the role and importance of digital marketing in

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	today's rapidly changing business environment..
CO2:	To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
CO3:	To know the key elements of a digital marketing strategy.
CO4:	To study how the effectiveness of a digital marketing campaign can be measured
CO5:	To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

Textbooks:	
1.	Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;
2.	First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
3.	Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
4.	Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
5.	Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited..
6.	Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
7.	Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	1	3	-	-	1	2	3	3	3	3	3
CO2:	2	2	2	1	3	-	-	1	2	3	3	3	3	3
CO3:	1	1	1	2	2	-	-	1	2	1	1	3	2	1
CO4:	3	2	2	3	1	-	-	1	3	2	3	2	3	2
CO5:	2	3	1	3	3	-	-	2	3	1	2	1	2	1
Average	2.2	2.2	1.6	2	2.4	-	-	1.2	2.4	2	2.4	2.4	2.6	2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2428	MULTIMEDIA DATA COMPRESSION AND STORAGE	PEC	2	0	2	3

Course Objectives:

- To understand the basics of compression techniques
- To understand the categories of compression for text, image and video
- To explore the modalities of text, image and video compression algorithms
- To know about basics of consistency of data availability in storage devices
- To understand the concepts of data streaming services

UNIT – I	**BASICS OF DATA COMPRESSION**	**6**
Introduction - Lossless and Lossy Compression - Basics of Huffmann coding - Arithmetic coding - Dictionary techniques - Context based compression - Applications.		
UNIT – II	**IMAGE COMPRESSION**	**6**
Lossless Image compression – JPEG-CALIC-JPEG LS-Prediction using conditional averages – Progressive Image Transmission – Lossless Image compression formats – Applications - Facsimile encoding		
UNIT – III	**VIDEO COMPRESSION**	**6**
Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.		
UNIT – IV	**DATA PLACEMENT ON DISKS**	**6**
Statistical placement on Disks – Striping on Disks – Replication Placement on Disks – Constraint allocation on Disks – Tertiary storage Devices – Continuous Placement on Hierarchical storage system – Statistical placement on Hierarchical storage systems – Constraint allocation on Hierarchical storage system.		
UNIT – V	**DISK SCHEDULING METHODS**	**6**
Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams.		
		Total Contact Hours : 30

LISTOF EXPERIMENTS

1. Construct Huffman codes for given symbol probabilities.
2. Encode run lengths with fixed-length code.
3. Lempel-Ziv algorithm for adaptive variable-length encoding
4. Compress the given word using arithmetic coding based on the frequency of the letters.
5. Write a shell script, which converts all images in the current directory in JPEG.

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6. Write a program to split images from a video without using any primitives.
7. Create a photo album of a trip by applying appropriate image dimensions and format.
8. Write the code for identifying the popularity of content retrieval from media server.
9. Write the code for ensuring data availability in disks using strip based method.
10. Program for scheduling requests for data streams.
Total Contact Hours : 30

Course Outcomes	Upon completion the course students should be able to:
CO1:	Understand the basics of text, Image and Video compression
CO2:	Understand the various compression algorithms for multimedia content.
CO3:	Explore the applications of various compression techniques.
CO4:	Explore knowledge on multimedia storage on disks.
CO5:	Understand scheduling methods for request streams.

Textbooks:	
1.	Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems, 2018, 5th Edition.
2.	Philip K.C.Tse, Multimedia Information Storage and Retrieval: Techniques and Technologies, 2008

References:	
1.	David Salomon, A concise introduction to data compression, 2008.
2.	Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017.
3.	Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor& Francis,2019
4.	Irina Bocharova, Compression for Multimedia, Cambridge University Press; 1st edition, 2009

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	1	1	-	-	-	-	-	-	2	2	2
CO2:	3	2	2	1	2	-	-	-	-	-	-	2	2	2
CO3:	3	2	2	1	2	-	-	-	-	-	-	2	2	2
CO4:	3	2	2	1	1	-	-	-	-	-	-	2	2	2

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CO5:	3	2	2	1	1	-	-	-	-	-	-	2	2	2
Average	3	2	2	1	1.4	-	-	-	-	-	-	2	2	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2429	**GAME DEVELOPMENT**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment

UNIT – I	**3D GRAPHICS FOR GAME DESIGN**	**6**
Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation – Controller Based Animation.		
UNIT – II	**GAME DESIGN PRINCIPLES**	**6**
Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.		
UNIT – III	**GAME ENGINE DESIGN**	**6**
Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.		
UNIT – IV	**OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS**	**6**
Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player game.		
UNIT – V	**GAME DEVELOPMENT USING PYGAME**	**6**
Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.		
	Total Contact Hours : 30	

LISTOF EXPERIMENTS

1. Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game.
2. Character design, sprites, movement and character control

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3. Level design: design of the world in the form of tiles along with interactive and collectible objects.	
4. Design of interaction between the player and the world, optionally using the physics engine	
5. Developing a 2D interactive using Pygame	
6. Developing a Puzzle game	
7. Design of menus and user interaction in mobile platforms.	
8. Developing a 3D Game using Unreal	
9. Developing a Multiplayer game using unity	
	Total Contact Hours : 30

Course Outcomes	Upon completion the course students should be able to:
CO1:	Explain the concepts of 2D and 3d Graphics
CO2:	Design game design documents.
CO3:	Implementation of gaming engines.
CO4:	Survey gaming environments and frameworks.
CO5:	Implement a simple game in Pygame.

Reference Books / Other Materials/ Web Resources:	
1.	Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley,2013.
2.	Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress,2007.
3.	Paul Craven, "Python Arcade games", Apress Publishers, 2016.
4.	David H. Eberly, "3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics", Second Edition, CRC Press, 2006.
5.	Jung Hyun Han, "3D Graphics for Game Programming", Chapman and Hall/CRC, 2011.

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	1	2	-	-	-	-	-	-	2	2	2
CO2:	1	2	2	1	2	-	-	-	-	-	-	2	2	1
CO3:	1	1	1	2	1	-	-	-	-	-	-	2	2	2
CO4:	3	3	1	3	3	-	-	-	-	-	-	2	2	3
CO5:	3	3	2	1	3	-	-	-	-	-	-	2	2	3
Average	2.2	2.2	1.6	1.6	2.2	-	-	-	-	-	-	2	2	2.2

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Subject Code	Subject Name	Category	L	T	P	C
CCS2430	VISUAL EFFECTS	PEC	2	0	2	3

Course Objectives:

- To get a basic idea on animation principles and techniques
- To get exposure to CGI, color and light elements of VFX
- To have a better understanding of basic special effects techniques
- To have a knowledge of state of the art vfx techniques
- To become familiar with popular compositing techniques

UNIT I	**ANIMATION BASICS**	**6**
VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.		
UNIT II	**CGI, COLOR, LIGHT**	**6**
CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model		
UNIT III	**SPECIAL EFFECTS**	**6**
Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects – wind, rain, fog, fire		
UNIT IV	**VISUAL EFFECTS TECHNIQUES**	**6**
Motion Capture, Matt Painting, Rigging, Front Projection. Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving		
UNIT V	**COMPOSITING**	**6**
Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP.		
	Total Contact Hours : 30	

LIST OF EXPERIMENTS

1.Using Natron:

- Understanding Natron Environment:
- Working with color and using color grading
- using Channels
- Merging images

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• Using Rotopaint • performing Tracking and stabilizing • Transforming elements • Stereoscopic compositing
2. Using Blender: • Motion Tracking – camera and object tracking • Camera fx, color grading, vignettes • Compositing images and video files • Multilayer rendering
Total Contact Hours : 30

Course Outcomes	Upon completion the course, students should be able to:
CO1:	To implement animation in 2D / 3D following the principles and techniques.
CO2:	To use CGI, color and light elements in VFX applications.
CO3:	To create special effects using any of the state of the art tools.
CO4:	To apply popular visual effects techniques using advanced tools.
CO5:	To use compositing tools for creating VFX for a variety of applications.

Textbooks:	
1.	Chris Roda, Real Time Visual Effects for the Technical Artist, CRC Press, 1st Edition, 2022
2.	Steve Wright, Digital Compositing for film and video, Routledge, 4th Edition, 2017.
3.	John Gress, Digital Visual Effects and Compositing**,** New Riders Press, 1st Edition, 2014.

Reference Books / Other Materials/ Web Resources:	
1.	Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2.	Robin Brinkman, The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3.	Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.
4.	Jasmine Katatikarn, Michael Tanzillo, "Lighting for Animation: The art of visual storytelling , Routledge, 1st Edition, 2016.
5.	Eran Dinur, "The Complete guide to Photorealism, for Visual Effects, Visualization
6.	Jeffrey A. Okun, Susan Zwerman, Christopher McKittrick, " The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures", Third Edition, 2020.and Games", Routledge, 1st Edition, 2022.
7.	https://www.blender.org/features/vfx/
8.	https://natrongithub.github.io/

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	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	3	3	1	-	-	1	2	1	1	3	3	2
CO2:	1	3	3	2	1	-	-	3	2	2	2	1	1	1
CO3:	2	3	3	2	1	-	-	1	2	1	2	2	2	2
CO4:	3	3	2	2	3	-	-	3	3	2	3	2	3	1
CO5:	1	2	1	1	2	-	-	1	3	2	3	2	3	1
Average	2	2.8	2.4	2	1.6	-	-	1.8	2.4	1.6	2	2	2.4	1.4

PROFESSIONAL ELECTIVE COURSES:VERTICAL-VI

Subject Code	Subject Name	Category	L	T	P	C
CCS2424	**AUGMENTED REALITY/ VIRTUAL REALITY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To impart the fundamental aspects and principles of AR/VR technologies.
- To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To know the technologies involved in the development of AR/VR based applications.

UNIT – I	**INTRODUCTION**	**7**
Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.		
UNIT – II	**VR MODELING**	**6**
Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants –Object Hierarchies – Viewing the 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – BehaviorModeling – Model Management.		
UNIT – III	**VR PROGRAMMING**	**6**

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VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D		
UNIT – IV	**APPLICATIONS**	**6**
Human Factors in VR – Methodology and Terminology – VR Health and Safety Issues – VR and Society-Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – Emerging Applications of VR – VR Applications in Manufacturing – Applications of VR in Robotics – Information Visualization – VR in Business – VR in Entertainment – VR in Education.		
UNIT – V	**AUGMENTED REALITY**	**5**
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation Navigation-Wearable devices		
		Total Contact Hours:30

LIST OF EXPERIMENTS	
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender	
2. Use the primitive objects and apply various projection types by handling camera.	
3. Download objects from asset store and apply various lighting and shading effects.	
4. Model three dimensional objects using various modelling techniques and apply textures over them.	
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.	
6. Add audio and text special effects to the developed application.	
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.	
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.	
9. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization and surgery simulation.	
10. Develop simple MR enabled gaming applications.	
	Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the basic concepts of AR and VR
CO2:	Understand the tools and technologies related to AR/VR
CO3:	Know the working principle of AR/VR related Sensor devices
CO4:	Design of various models using modeling techniques

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CO5:	Develop AR/VR applications in different domains

Textbooks:	
1.	Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile",Packt Publisher, 2018
2.	Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016
3.	John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
4.	William R. Sherman, Alan B. Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	-	3	-	-	2	2	1	2	2	1	2
CO2:	3	2	2	1	3	-	-	3	2	2	3	3	1	2
CO3:	3	3	2	2	3	-	-	3	2	1	2	3	2	2
CO4:	3	3	3	2	3	-	-	3	2	2	3	3	2	2
CO5:	3	3	3	3	3	-	-	3	3	3	3	3	3	3
Average:	3.00	2.60	2.40	2.00	3.00	-	-	2.80	2.20	1.80	2.60	2.80	1.80	2.20

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2431	**ROBOTIC PROCESS AUTOMATION**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

UNIT – I	**INTRODUCTION TO ROBOTIC PROCESS AUTOMATION**	**6**
Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.		
UNIT – II	**AUTOMATION PROCESS ACTIVITIES**	**6**
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events		

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UNIT – III	**APP INTEGRATION, RECORDING AND SCRAPING**	**6**
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.		
UNIT – IV	**EXCEPTION HANDLING AND CODE MANAGEMENT**	**6**
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.		
UNIT – V	**DEPLOYMENT AND MAINTENANCE**	**6**
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA		
		Total Contact Hours:30

LIST OF EXPERIMENTS
1. Create a Sequence to obtain user inputs display them using a message box.
2. Create a Flowchart to navigate to a desired page based on a condition.
3. Create a State Machine workflow to compare user input with a random number.
4. Build a process in the RPA platform using UI Automation Activities.
5. Create an automation process using key System Activities, Variables and Arguments
6. Also implement Automation using System Trigger
7. Automate login to (web)Email account
8. Recording mouse and keyboard actions.
9. Scraping data from website and writing to CSV
10. Implement Error Handling in RPA platform
11. Web Scraping
12. Email Query Processing
Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Enunciate the key distinctions between RPA and existing automation techniques and platforms.
CO2:	Use UiPath to design control flows and work flows for the target process

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CO3:	Implement recording, web scraping andprocess mining by automation
CO4:	Use UIPath Studio to detect, and handle exceptions in automation processes
CO5:	Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

Textbooks:	
1.	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2.	Tom Taulli , "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems",Apress publications, 2020.

Reference Books/Other Materials/WebResources:	
1.	Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2.	Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3.	A Gerardus Blokdyk, "Robotic Process Automation RpaA Complete Guide ", 2020

	CO-PO Mapping											**CO-PSO Mapping**		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	2	1	3	-	-	1	3	3	2	2	2	1
CO2:	1	1	2	3	3	-	-	1	2	3	1	3	2	1
CO3:	2	3	2	3	3	-	-	2	3	1	1	3	3	3
CO4:	1	2	1	2	2	-	-	1	2	1	3	3	3	2
CO5:	3	3	3	3	3	-	-	3	1	1	1	3	2	1
Average:	2	2.2	2	2.4	2.8	-	-	1.6	2.2	1.8	1.6	2.8	2.4	1.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2401	**NEURAL NETWORKS AND DEEP LEARNING**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks

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• To analyze the key computations underlying deep learning, then use them to build and traindeep neural networks for various tasks
• To apply autoencoders and generative models for suitable applications.

UNIT – I	**INTRODUCTION**	**6**
Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network.		
UNIT – II	**ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS**	**6**
Training Algorithms for Pattern Association-Autoassociative Memory Network-Heteroassociative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Autoassociative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network.		
UNIT – III	**THIRD-GENERATION NEURAL NETWORKS**	**6**
Spiking Neural Networks-Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms – Neuroscientific Basis – Applications: Computer Vision, Image Generation, Image Compression.		
UNIT – IV	**DEEP FEEDFORWARD NETWORKS**	**6**
History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.		
UNIT – V	**RECURRENT NEURAL NETWORKS**	**6**
Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders.		
		Total Contact Hours:30

LIST OF EXPERIMENTS
1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Improve the Deep learning model by fine tuning hyper parameters.
7. Implement a Transfer Learning concept in Image Classification.
8. Using a pre trained model on Keras for Transfer Learning

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9. Perform Sentiment Analysis using RNN
10. Implement an LSTM based Autoencoder in TensorFlow/Keras.
11. Image generation using GAN
ADDITIONAL EXPERIMENTS
12. Train a Deep learning model to classify a given image using pre trained model
13. Recommendation system from sales data using Deep Learning
14. Implement Object Detection using CNN
15. Implement any simple Reinforcement Algorithm for an NLP problem
Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Apply Convolution Neural Network for image processing.
CO2:	Understand the basics of associative memory and unsupervised learning networks.
CO3:	Apply CNN and its variants for suitable applications.
CO4:	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
CO5:	Apply autoencoders and generative models for suitable applications.

Textbooks:	
1.	Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
2.	Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021.

Reference Books/Other Materials/WebResources:	
1.	Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly, 2018.
2.	Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
3.	Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
4.	Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5.	Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6.	Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
7.	S Rajasekaran, G A Vijayalakshmi Pai, "Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.

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8.	Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
9.	James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	2	3	2	3	1	-	2	1	-	-	2	2	1
CO2:	3	1	2	1	-	-	-	-	1	2	2	-	1	-
CO3:	3	3	3	3	3	1	-	2	1	-	-	2	2	1
CO4:	3	3	3	3	3	-	-	2	-	2	3	2	2	2
CO5:	1	1	3	2	3	-	-	2	-	-	-	1	1	-
Average:	2.6	2	2.8	2.2	2.4	0.4	0	1.6	0.6	0.8	1	1.4	1.6	0.8

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2432	**CYBER SECURITY**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To learn cybercrime and cyberlaw.
- To understand the cyber attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber attack.
- To learn how to prevent a cyber attack.

UNIT – I	**INTRODUCTION**	**6**
Cyber Security – History of Internet – Impact of Internet – CIA Triad; Reason for Cyber Crime – Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.		
UNIT – II	**ATTACKS AND COUNTERMEASURES**	**6**
OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks – Security Breach – Types of Malicious Attacks – Malicious Software – Common Attack Vectors – Social engineering Attack – Wireless Network Attack – Web Application Attack – Attack Tools – Countermeasures.		
UNIT – III	**RECONNAISSANCE**	**6**
Harvester – Whois – Netcraft – Host – Extracting Information from DNS – Extracting Information from E-mail Servers – Social Engineering Reconnaissance; Scanning – Port Scanning – Network Scanning and Vulnerability Scanning – Scanning Methodology – Ping Sweer Techniques – Nmap Command Switches – SYN – Stealth – XMAS – NULL – IDLE – FIN Scans – Banner Grabbing and OS Finger printing Techniques.		
UNIT – IV	**INTRUSION DETECTION**	**6**

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Host -Based Intrusion Detection – Network -Based Intrusion Detection – Distributed or Hybrid Intrusion Detection – Intrusion Detection Exchange Format – Honeypots – Example System Snort.		
UNIT – V	**INTRUSION PREVENTION**	**6**
Firewalls and Intrusion Prevention Systems: Need for Firewalls – Firewall Characteristics and Access Policy – Types of Firewalls – Firewall Basing – Firewall Location and Configurations – Intrusion Prevention Systems – Example Unified Threat Management Products.		
	Total Contact Hours:30	

LIST OF EXPERIMENTS
1. Install Kali Linux on Virtual box
2. Explore Kali Linux and bash scripting
3. Perform open source intelligence gathering using Net craft, Who is Lookups, DNS Reconnaissance, Harvester and Maltego
4. Understand the nmap command d and scan a target using nmap
5. Install metasploitable2 on the virtual box and search for unpatched vulnerabilities
6. Use Metasploit to exploit an unpatched vulnerability
7. Install Linus server on the virtual box and install ssh
8. Use Fail2banto scan log files and ban Ips that show the malicious signs
9. Launch brute-force attacks on the Linux server using Hydra.
10. Perform real-time network traffic analysis and data pocket logging using Snort
Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Explain the basics of cyber security, cyber crime and cyber law (K2)
CO2:	Classify various types of attacks and learn the tools to launch the attacks (K2)
CO3:	Apply various tools to perform information gathering (K3)
CO4:	Apply intrusion techniques to detect intrusion (K3)
CO5:	Apply intrusion prevention techniques to prevent intrusion (K3)

Textbooks:	
1.	Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021 (Unit 1)
2.	Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011 (Unit 1)
3.	https://owasp.org/www-project-top-ten/
Reference Books/Other Materials/WebResources:	
1.	David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013 (Unit 2)

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2.	Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011 (Unit 3)
3.	Kimberly Graves, "CEH Official Certified Ethical hacker Review Guide", Wiley Publishers, 2007 (Unit 3)
4.	William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015 (Units 4 and 5)
5.	Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2014 (Lab)

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
1	1	1	1	1	-	1	-	-	-	1	-	2	2	2
2	1	3	1	3	2	1	-	-	-	-	-	2	2	1
3	2	1	1	1	-	1	-	-	-	1	-	2	2	2
4	3	3	2	2	2	1	-	-	-	-	-	2	2	3
5	3	2	1	1	1	1	1	-	-	1	-	2	2	2
Average:	2	2	1.2	1.6	1	1	0.2	0	0	0.6	0	2	2	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2423	**CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

UNIT – I	**INTRODUCTION TO BLOCKCHAIN**	**7**
Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree		
UNIT – II	**BITCOIN AND CRYPTOCURRENCY**	**6**
A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay		
UNIT – III	**BITCOIN CONSENSUS**	**6**
Bitcoin Consensus, Proof of Work (PoW)- HashcashPoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.		
UNIT – IV	**HYPERLEDGER FABRIC & ETHEREUM**	**5**
Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.		

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UNIT – V	BLOCKCHAIN APPLICATIONS	6
Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.		
		Total Contact Hours:30

LIST OF EXPERIMENTS
1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.
2. Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.
3. Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.
4. Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.
5. Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.
Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand emerging abstract models for Blockchain Technology
CO2:	Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
CO3:	It provides conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
CO4:	Apply hyperledger Fabric and Ethereum platform to implement the Block chain Application.

Textbooks:	
1.	Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2.	Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

Reference Books/Other Materials/WebResources:	
1.	Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017.

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2.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3.	Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4.	Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing.
5.	Handbook of Research on Blockchain Technology published by Elsevier Inc. ISBN: 9780128198162, 2020.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	3	2	2	1	-	-	1	-	-	2	3	1	1
CO2:	3	3	3	3	1	-	-	2	-	-	2	1	2	1
CO3:	3	3	3	3	2	-	-	3	-	-	2	2	2	3
CO4:	3	2	3	2	3	-	-	3	-	-	2	2	2	3
Average:	3	2.75	2.75	2.5	1.75	-	-	2.25	-	-	2	2	2.75	2

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2438	**COGNITIVE SCIENCE**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition**.**

UNIT – I	**PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE**	**6**
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.		
UNIT – II	**COMPUTATIONAL INTELLIGENCE**	**6**
Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Learning – Language – Vision.		
UNIT – III	**PROBABILISTIC PROGRAMMING LANGUAGE**	**6**
WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration		
UNIT – IV	**INFERENCE MODELS OF COGNITION**	**6**

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Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.		
UNIT – V	**LEARNING MODELS OF COGNITION**	**6**
Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.		
		Total Contact Hours:30

LIST OF EXPERIMENTS	
1. Demonstration of Mathematical functions using Web PPL.	
2. Implementation of reasoning algorithms.	
3. Developing an Application system using generative model.	
4. Developing an Application using conditional inference learning model.	
5. Application development using hierarchical model.	
6. Application development using Mixture model.	
	Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Understand the underlying theory behind cognition.
CO2:	Connect to the cognition elements computationally.
CO3:	Implement mathematical functions through WebPPL.
CO4:	Develop applications using cognitive inference model.
CO5:	Develop applications using cognitive learning model.

Textbooks:	
1.	Vijay V Raghavan,VenkatN.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2.	Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
3.	Robert A. Wilson, Frank C. Keil, "The MIT Encyclopedia of the Cognitive Sciences",The MIT Press, 1999.
4.	Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

Reference Books/Other Materials/WebResources:	
1.	Noah D. Goodman, Andreas Stuhlmuller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.

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2.	Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1:	3	1	3	2	2	-	-	1	1	2	2	1	2	2
CO2:	2	2	1	1	2	-	-	3	2	3	1	2	3	2
CO3:	1	3	1	3	3	-	-	1	3	1	3	3	1	2
CO4:	2	1	1	2	3	-	-	1	2	3	1	3	3	1
CO5:	1	2	3	2	2	-	-	1	2	1	2	2	2	1
Average:	1.8	1.8	1.8	2	2.4	-	-	1.4	2	1.8	1.8	2.2	2.2	1.6

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**C**
CCS2434	**3D PRINTING AND DESIGN**	**PEC**	**2**	**0**	**2**	**3**

Course Objectives:

- To discuss on basics of 3D printing
- To explain the principles of 3D printing technique
- To explain and illustrate inkjet technology
- To explain and illustrate laser technology
- To discuss the applications of 3D printing

UNIT – I	**INTRODUCTION**	**6**
Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats		
UNIT – II	**PRINCIPLE**	**6**
Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations;		
UNIT – III	**INKJET TECHNOLOGY**	**6**
Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based fabrication – Colourjet.		
UNIT – IV	**LASER TECHNOLOGY**	**6**
Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures;		
UNIT – V	**INDUSTRIAL APPLICATIONS**	**6**
Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends;		

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	Total Contact Hours:30

LIST OF EXPERIMENTS
1. Study the interface and basic tools in the CAD software.
2. Study 3D printer(s) including print heads, build envelope, materials used and relatedsupport removal system(s).
3. Review of geometry terms of a 3D mesh.
4. Commands for moving from 2D to 3D.
5. Advanced CAD commands to navigate models in 3D space
6. Design any four everyday objects Refer to web sites like Thingiverse, Shapeways and GitFab to design four everyday objects that utilize the advantages of 3D printing. Choose four models from a sharing site like Thingiverse, Shapeways or Gitfab. a. Improve upon a file and make it your own. Some ideas include: • Redesign it with a specific user in mind • Redesign it for a slightly different purpose Improve the look of the product
7. Use the CAM software to prepare files for 3D printing.
8. Manipulate machine movement and material layering.
9. Repair a 3D mesh using a) Freeware utilities: Autodesk MeshMixer (http://goo.gl/x5nhYc), MeshLab (http://goo.gl/fgztLl) or Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a) b) Freeware tool tutorials: Netfabb Basic or Cloud Service (http://goo.gl/Q1P47a), Netfabb and MeshLab (http://goo.gl/WPOVec) c) Professional tools: Magics or Netfabb Equipment : one 3D printer for every 10-15 students
Total Contact Hours:30

Course Outcomes:	Upon completion of the course students should be able to:
CO1:	Outline and examine the basic concepts of 3D printing technology
CO2:	Outline 3D printing workflow`
CO3:	Explain and categorise the concepts and working principles of 3D printing using inkjet technique
CO4:	Explain and categorise the working principles of 3D printing using laser technique
CO5:	Explain various method for designing and modeling for industrial applications

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Textbooks:	
1.	Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2.	Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.

Reference Books/Other Materials/WebResources:	
1.	Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2.	Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3.	Joan Horvath, Mastering 3D Printing, APress, 2014

	CO-PO Mapping											CO-PSO Mapping		
PO& PSO / CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
1	1	1	2	2	3	1	-	2	-	2	2	3	2	1
2	3	2	3	3	3	2	-	3	-	3	2	3	2	3
3	2	2	2	2	2	2	-	2	-	2	2	3	2	2
4	2	2	2	2	3	2	-	2	-	2	2	3	3	2
5	1	3	3	3	3	3	-	3	-	3	3	3	3	1
Average:	1.8	2	2.4	2.4	2.8	2	-	2.4	-	2.4	2.2	3	2.4	1.8

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