DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR-621 212

REGULATIONS - 2023

CHOICE BASED CREDIT SYSTEM

B.Tech., ARTIFICIAL INTELLIGENCE & DATA SCIENCE

CURRICULUM & SYLLABI

DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

Discussed in BOS-4 meeting Dated: 22.08.2024 / AI&DS Ratified & Approved in Academic Council

VISION & MISSION OF THE INSTITUTION

Vision:

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

Mission:

M1 To develop eminent scholar with a lifelong, follow up of global standards by offering UG,PG and Doctoral Programmers.

M2 To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.

M3 To promote sustained research and training with emphasis on human values and leadership qualities.

M4 To contribute solutions for the need based issues of our society by proper ways and meansas dutiful citizen.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

About the Department

Artificial Intelligence and Data Science (AI & DS) is an outstanding course of current software programming / coding scenario. This Programme is being identified as the worldwide Emerging and Thrust areas of today's Engineering field and was listed in the AICTE (All India Council for Technical Education): "Model Curriculum of Courses at UG Level in Emerging and Thrust Areas".

In DSEC, B. Tech (Artificial Intelligence and Data Science) is offered as a four years Full time Under Graduate (UG) Programme for the students. This programme is offered with a motto of preparing the student as an intelligent data analyst which is the key component in numerous real-world applications.

Vision:

To develop globally competitive professionals in the field of Artificial Intelligence (AI) & Data Science (DS) by imparting cognitive learning of AI&DS tools with basic Computer Science Knowledge and by encouraging Global Industrial collaboration towards serving the greater cause of Engineering Society.

Mission:

M1 Impart knowledge in cutting edge Artificial Intelligence and Data Science technologies in par with industrial standards

M2 Inculcate research and lifelong learning that benefit society at large which promotes ethical values and entrepreneurial skills

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Artificial Intelligence and Data Science.
PEO 2	Graduates will be able to successfully pursue higher education in reputed institutions with AI Specialization
PEO 3	Graduates will have the ability to explore research areas and produce outstanding contribution in various areas of Artificial Intelligence and Data science

PROGRAM OUTCOMES (POs)

PO	Graduate Attribute
PO 1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO 3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO 4	**Conduct investigations of complex problems:** Use research based knowledge andresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO 10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO 11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1	To collect requirements, analyze, design, implement and test software Systems.
PSO 2	To analyze the errors and debug them accordingly
PSO 3	To impart the Knowledge to implement AI Programming

PEO's – PO's & PSO's MAPPING:

PEO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I.	3	3	3	3	3	3	-	-	3	3	2	3	3	3	3
II.	3	3	3	3	3	2	-	-	2	-	2	2	3	3	3
III.	3	3	3	3	3	2	-	-	2	2	2	3	3	3	3

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE
(AUTONOMOUS), PERAMBALUR – 621 212.
B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IP3151	Induction Programme	-	-	-	-	-	-
2	U23HST11	Communicative English	HS	3	0	0	45	3
3	U23MAT12	Matrices and Calculus	BS	3	1	0	60	4
4	U23PHT13	Physics for Engineers and Technologists	BS	3	0	0	45	3
5	U23CYT14	Chemistry for Engineering & Technology	BS	3	0	0	45	3
6	U23GET15	Problem Solving and Python Programming	ES	3	0	0	45	3
7	GE3152	தமிழர் மரபு / Heritage of Tamils	HS	1	0	0	15	1
PRACTICAL								
8	U23GEP13	Problem Solving and Python Programming Laboratory	ES	0	0	4	60	2
9	U23BSP11	Physics and Chemistry Laboratory	BS	0	0	4	60	2
10	U23HSP12	English Laboratory	EEC	0	0	2	30	1

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23HST21	Professional English	HS	2	0	0	30	2
2	U23MAT22	Statistics and Numerical Methods	BS	3	1	0	60	4
3	U23PHT25	Physics for Information Science	BS	3	0	0	45	3
4	U23EET23	Basic Electrical and Electronics Engineering	ES	3	0	0	45	3
5	U23ECT23	Digital Principles and System Design	ES	3	1	0	60	4
6	U23CST21	Programming in C	PC	3	0	0	45	3
7		NCC Credit Course Level 1	-	-	-	-	-	2*
8	GE3252	தமிழரும் தொழில்நுட்பமும் / Tamils and Technology	HS	1	0	0	15	1
PRACTICAL								
9	U23CSP21	Programming in C Laboratory	PC	0	0	4	4	2
10	U23HSP22	Communication Laboratory	EEC	0	0	4	4	2

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23AIT31	Database Management System	PC	3	0	0	45	3
2	U23AIT32	Data Structures	PC	3	0	0	45	3
3	U23AIT33	Computer Organization and Architecture	PC	3	0	0	45	3
4	U23AIT34	Design and Analysis of Algorithms	PC	3	1	0	60	4
5	U23AIT35	Design Thinking for AI	PC	3	0	0	45	3
PRACTICAL								
6	U23AIP31	Database Management Systems Laboratory	PC	0	0	4	60	2
7	U23AIP32	Data Structures Laboratory	PC	0	0	4	60	2

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23MAT41	Probability and Statistics	BS	3	1	0	60	4
2	U23AIT41	Artificial Intelligence	PC	3	0	0	45	3
3	U23AIT42	Data Science	PC	3	0	0	45	3
4	U23CST43	Operating Systems	PC	3	0	0	45	3
5	U23AIT44	Fundamentals of Computer Networks and communication	PC	3	0	0	45	3
6	U23GET41	Environmental Sciences and Engineering	BS	2	0	0	30	2
PRACTICAL								
7	U23AIP41	Artificial Intelligence Laboratory	PC	0	0	4	60	2
8	U23AIP42	Data Science Laboratory	PC	0	0	4	60	2

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CST42	Machine Learning	PC	3	0	0	45	3
2	U23AIT52	Big Data Analytics	PC	3	0	0	45	3
3		Open Elective - I	OE	3	0	0	45	3
4	U23AIT53	Data Exploration and Visualization	PC	3	0	0	45	3
5	U23AIV1	Professional Elective - I	PE	3	0	0	45	3
6	U23AIV2	Professional Elective - II	PE	3	0	0	45	3
PRACTICAL								
7	U23CSP42	Machine Learning Laboratory	PC	0	0	4	60	2
8	U23AIP52	Big Data Analytics Laboratory	PC	0	0	4	60	2

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23AIT61	IOT and Applications	PC	3	0	0	45	3
2	U23AIT62	Deep Learning	PC	3	0	0	45	3
3		Open Elective - II	OE	3	0	0	45	3
4	U23AIV3	Professional Elective - III	PE	3	0	0	45	3
5	U23AIV4	Professional Elective - IV	PE	3	0	0	45	3
PRACTICAL								
6	U23AIP61	IOT and Applications Laboratory	PC	0	0	4	60	2
7	U23AIP62	Mini Project	PC	0	0	4	60	2

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CST72	Natural Language Processing	PC	3	0	0	45	3
2	U23AIT72	Robotics and Automation	PC	3	0	0	45	3
3	U23AIT73	Augmented Intelligence	PC	3	0	0	45	3
4	U23AIT74	Universal Human Values and Ethics	ES	3	0	0	45	3
5	U23AIT75	Entrepreneur and Startup	EEC	3	0	0	45	3
PRACTICAL								
6	U23AIP71	Natural Language Processing Laboratory	PC	0	0	4	60	2
7	U23AIP72	Training & Internship	EEC	1	0	0	15	1

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23AIV5	Professional Elective - V	PE	3	0	0	45	3
2	U23AIV6	Professional Elective - VI	PE	3	0	0	45	3
PRACTICAL								
3	U23AIP81	Project Work	EEC	0	0	20	300	10

VERTICAL – I
(DATA SCIENCE)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CSV67	Knowledge Engineering	PE	3	0	0	45	3
2	U23AIV12	Recommender Systems	PE	3	0	0	45	3
3	U23AIV13	Soft Computing	PE	3	0	0	45	3
4	U23CSV14	Text and Speech Analysis	PE	3	0	0	45	3
5	U23CSV15	Business Analytics	PE	3	0	0	45	3
6	U23CSV16	Image and video analytics	PE	3	0	0	45	3
7	U23CBT51	Theory of Computation	PE	3	0	0	45	3

VERTICAL – II
(FULL STACK DEVELOPMENT)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CSV22	App Development	PE	3	0	0	45	3
2	U23CSV23	Cloud Services Management	PE	3	0	0	45	3
3	U23EET62	Embedded Systems	PE	3	0	0	45	3
4	U23CSV25	Software Testing and Automation	PE	3	0	0	45	3
5	U23CSV26	Web Application Security	PE	3	0	0	45	3
6	U23CSV17	Computer Vision	PE	3	0	0	45	3

VERTICAL – III
(CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CST71	Cloud Computing	PE	3	0	0	45	3
2	U23ITV31	Data Warehousing	PE	3	0	0	45	3
3	U23ITV65	Optimization Techniques	PE	3	0	0	45	3
4	U23ITV67	Game Theory	PE	3	0	0	45	3
5	U23AIV34	Java Programming	PE	3	0	0	45	3
6	U23CSV58	Cognitive Science	PE	3	0	0	45	3

VERTICAL – IV
(CYBER SECURITY AND DATA PRIVACY)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CSV63	Cyber Security	PE	3	0	0	45	3
2	U23CSV34	Storage Technologies	PE	3	0	0	45	3
3	U23CSV46	Cryptocurrency and Block chain Technologies	PE	3	0	0	45	3
4	U23AIV44	R Programming	PE	3	0	0	45	3
5	U23AIV45	Data and Information Security	PE	3	0	0	45	3
6	U23CSV44	Modern Cryptography	PE	3	0	0	45	3

VERTICAL – V
(CREATIVE MEDIA)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23CSV52	Multimedia and Animation	PE	3	0	0	45	3
2	U23AIV52	Video Creation and Editing	PE	3	0	0	45	3
3	U23CSV54	Digital marketing	PE	3	0	0	45	3
4	U23CSV57	Multimedia Data Compression and Storage	PE	3	0	0	45	3
5	U23ITV27	DevOps	PE	3	0	0	45	3
6	U23AIV56	Ethics and AI	PE	3	0	0	45	3

VERTICAL – VI
(EMERGING TECHNOLOGIES)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23AIV61	Distributed Computing	PE	3	0	0	45	3
2	U23CSV66	3D Printing and Design	PE	3	0	0	45	3
3	U23CBT63	Ethical Hacking	PE	3	0	0	45	3
4	U23ITV41	Digital and Mobile Forensics	PE	3	0	0	45	3
5	U23AIV65	Human Computer Interaction	PE	3	0	0	45	3
6	U23AIV66	Information Retrieval	PE	3	0	0	45	3
7	U23CSV64	Quantum Computing	PE	3	0	0	45	3

OPEN ELECTIVE

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23AIO01	Machine Learning Techniques	OE	3	0	0	45	3
2	U23CST62	Internet of Things	OE	3	0	0	45	3
3	U23AIT41	Artificial Intelligence	OE	3	0	0	45	3
4	U23AIO04	Introduction to Data Science	OE	3	0	0	45	3
5	U23AIO05	Data visualization	OE	3	0	0	45	3
6	U23ITT43	Web Technology	OE	3	0	0	45	3
7	U23AIV61	Distributed computing	OE	3	0	0	45	3
8	U23AIO08	Grid Computing	OE	3	0	0	45	3
9	U23AIO09	Augmented Reality & Virtual Reality	OE	3	0	0	45	3
10	U23CST72	Natural Language Processing	OE	3	0	0	45	3
11	U23CSV46	Cryptocurrency and Blockchain Technologies	OE	3	0	0	45	3

SUMMARY

Sl. No.	Subject Area	Credits per semester								Credits Total	Percentage %
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities and Social Sciences (HS)	4	3	-	-	-	-	-	-	17	10.43
2	Basic Sciences (BS)	12	7	-	6	-	-	-	-	25	15.34
3	Engineering Sciences (ES)	5	7	-	-	-	-	3	-	15	9.20
4	Professional Core (PC)	-	5	20	16	13	10	11	-	75	46.01
5	Professional Elective (PE)	-	-	-	-	6	6	-	6	18	11.04
6	Open Elective (OE)	-	-	-	-	3	3	-	-	6	3.68
7	Employability Enhancement Courses (EEC)	1	2	-	-	-	-	4	10	17	10.43
	Total	**22**	**24**	**20**	**22**	**22**	**19**	**18**	**16**	**163**	**100%**

SEMESTER – I

		L	T	P	C
IP3151	**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:

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 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 every day 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.

(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 don'ts, 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, AI&DS, CSE and IT students may be introduced to activities that kindle computational thinking, and 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.

U23HST11	COMMUNICATIVE ENGLISH (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To enhance students listening ability for academic and Professional purposes.
2. To learn to use basic grammatical structures in suitable contexts
3. To help students acquire the ability to speak effectively in English in real - life situations.
4. To help learners use language effectively in professional contexts.
5. To develop students' ability to read and write complex texts, summaries, articles, definitions, Paragraph user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

Define communication. Kinds of communication. Quintessential of communication in technical progression. Key characteristics of an effective communicator- listening, attitude modification, way of response with appropriate language, tone modulation.

Listening- Listening to TV news, Guest lectures. Speaking- Answering the Questions.

Reading - Reading brochures and technical magazines (technical context), telephone messages / social media messages relevant to technical contexts and emails, **Writing**-Reading comprehension, Parts of Speech.

UNIT II READING QUEST 9

Listening- listening and responding to video lectures/talks. **Speaking**- Day today conversations. **Reading** –Edison of India-GD Naidu "The Great Inventor". **Writing**- Emails / Informal Letters - Inviting, Congratulating & Thanking, Punctuations.

UNIT III LANGUAGE RESOURCE GROWS CRITICAL JUDGEMENT 9

Listening- listening to specific task-focused audio tracks. **Speaking**- summary of Robert Frost "Stopping by woods on a snowy evening". **Reading** – Reading advertisements, gadget reviews; user manuals. **Writing** – Essay Writing: Analytical essay: Narrative Essay, Developing Hints, Usage of tenses in sentence formation. Voices.

UNIT IV LANGUAGE IN LIFE SKILL 9

Listening- Listening to speech of Great Scholars. Speaking- mechanics of presentation. **Reading** – Newspaper articles, power point presentation. **Writing** – Checklist, Jumbled Sentences - Rearrange the sentences in correct order, WH-Questions-Form questions by using statements, Prefixes and Suffixes.

UNIT V IMPROVING SPEAKING &READING 9

Listening- listening to situational based dialogues; **Speaking**- Stating intention to do something-Expressing opinion-asking people to repeat themselves**. Reading** – Summary of O. Henry's "The last Leaf". **Writing** – Dialogue Writing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Remember appropriate words in a situational conversation.
CO 2: Gain understanding of basic grammatical structures and use them in right context.
CO 3: Read and infer the denotative and connotative meanings of technical texts.
CO 4: Write Dialogue, Letter and paragraphs on various topics.
CO 5: Make the students prepare effective notes for main sources available.
CO 6: Enhance them to give operational talk.

TEXT BOOKS:

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.
3. "The Gift of the Magi" by O.Henry, McClure, Philips and company.

REFERENCE BOOKS:

1. Meenakshi Raman & Sangeeta Sharma, "Technical Communication – Principles and Practices", Oxford Univ. Press, 2016, New Delhi.
2. Lakshminarayanan, "A Course Book on Technical English", SciTech Publications (India) Pvt.Ltd.
3. AyshaViswamohan, "English for Technical Communication (With CD)", McGraw Hill Education.
4. Kulbhusan Kumar, RS Salaria, "Effective Communication Skill", Khanna Publishing House.
5 Dr. V. Chellammal, "Learning to Communicate", Allied Publishing House, New Delhi,2003.

U23MAT12	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To familiarize the student with functions of several variables
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems

UNIT I MATRICES 12

Introduction – Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton theorem – Diagonalization of the matrices by Orthogonal Transformations – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS 12

Limit of a function – Continuity – Derivatives – Differentiation rules – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variable.

UNIT III MULTIVARIABLE CALCULUS 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRAL AND THEIR APPLICATIONS 12

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.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients– Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients – Method of undetermined coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO 1: Use the matrix algebra methods for solving practical problems.

CO 2: Use both the limit definition and rules of differentiation to differentiate functions.

CO 3: Apply differential calculus tools in solving various application problems.

CO 4: Able to use differential calculus ideas on several variable functions.

CO 5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

CO 6: Solve the ordinary differential equations using different techniques for that model engineering problems.

TEXT BOOKS:

1. Kreyszig. E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal. B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 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:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics",Narosa Publications, New Delhi, 5th Edition,2016.
3. Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016
5. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

U23PHT13	PHYSICS FOR ENGINEERS AND TECHNOLOGISTS (COMMON TO ALL B.E./ B.TECH. PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to gain the knowledge in elastics and plastic nature of the materials in the presence and absence of load.
2. To understand the students to know the application of the sound waves in different fields.
3. To motivate the students towards the applications of photo electric phenomena.
4. To know the physical principle of LASER, the working of LASER applications.
5. To understand the propagation of light in optical fibers and its applications.

UNIT I ELASTICITY **9**

Introduction- Elasticity - plasticity– Hooke's law - relationship between three Modulii of elasticity (Qualitative) – stress & strain diagram and its uses -Poisson's ratio - factors affecting elasticity - twisting couple of wire - Torsion Pendulum: theory and experiment.

Beam: Internal bending moment – Cantilever: theory and experiment – Young's Modulus: uniform and non – uniform bending (Qualitative) – I-shaped girders- advantages and applications.

UNIT II ULTRASONICS **9**

Introduction – classification of sound- properties of infrasonic, audible and ultrasonics - production: Magnetostriction and Piezoelectric methods – determination of velocity of sound in liquid (Acoustic Grating Method) – general applications – industrial application: Non - Destructive Testing: pulse echo system through transmission and reflection modes. ultrasonic scanning methods – medical application: sonogram.

UNIT III MODERN PHYSICS **9**

Introduction –Black Body Radiation – Classical and Quantum Laws of Black Body Radiation - Photon and its Properties - Wave Particle Duality and Matter waves – De - Broglie Wavelength - Schrodinger's Time Independent and Time Dependent Wave Equations - Physical Significance of The Wave Function. Application: Particle in One Dimensional Box - Normalization Process – Photo Electric Effect – Laws Governing the Photoelectric Effect – Einstein's Formula - Derivation – Applications: Solar Cell – Solar Water Heater – Photo resistor (LDR).

UNIT IV LASERS **9**

Lasers: Introduction - Properties of Laser-Spontaneous and Stimulated Emission Process - Einstein's Theory of Matter Radiation Interaction & A and B Coefficients; Amplification of Light By Population Inversion – Pumping Methods - Types of Lasers: Solid-State Laser (Homo And Hetero Junction Semiconductor Lasers), Gas Laser (CO_2), Applications: Laser Cutting and Welding, LIDAR and Barcode Scanner.

UNIT V FIBER OPTICS AND APPLICATIONS **9**

Optical Fiber: Structure - advantages- Principle [TIR]–Propagation Phenomena in optical fiber - Expression For Acceptance Angle and Numerical Aperture – Relation between Refractive Index of

Core, Numerical Aperture and Fractional Index Change – Fabrication: Double Crucible Method - Types: Material, Mode, Refractive Index - Applications: Optical Fiber Communication System – fiber optic sensors (Displacement and pressure sensors) – Medical Endoscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Differentiate the elastic and plastic nature of the materials.
CO 2: Know the experimental techniques in both production and applications of ultrasonic waves.
CO 3: Gain knowledge in the basics of quantum mechanics concepts.
CO 4: Develop new devices based on LASER source.
CO 5: Understand the advantages of optical fiber than metal wire.
CO 6: Demonstrate some useful experiments based on optical fiber

TEXT BOOKS:

1. Dr. P. Mani, "Engineering Physics", Dhanam Publications, 2013.
2. Dr. G. Senthilkumar, "Engineering Physics", VRB Publishers, 2017.
3. K. Thyagarajan, Ajoy Ghatak, "Lasers Fundamentals and Applications" 2nd Edition, Springer, 2010.
4. D.K. Bhattacharya, Poonam Tandon," Engineering Physics", Oxford HED Publishers, 2017.

REFERENCE BOOKS:

1. Marikani, "Engineering Physics", PHI, New Delhi, 2013.
2. Bhattacharya & Bhaskaran, "Engineering Physics", Oxford Publications, 2012.
3. R Murugeshan, Kiruthiga, Sivaprasath S, "Modern Physics", Chand Publishing, 2021.
4. S. Rajivgandhi & A. Ravikumar, "Engineering Physics I", RK Publications, 2023
5. Sathyaprakash, "Quantum Mechanics", Pragati Prakashan, Meerut, 2016.

U23CYT14	CHEMISTRY FOR ENGINEERING & TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I WATER TREATMENT 9

Water: Sources, impurities, Parameters. Types of water Hardness of water -types – expression of hardness – units – Estimation of hardness of water by EDTA. Desalination - Reverse Osmosis. Boiler troubles: Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II ELECTRO AND NANO CHEMISTRY 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf by Poggendorff's compensation principle. Single electrode potential – Nernst equation – reference electrodes -types–Calomel electrode - electrolysis of water.

Nanomaterials: Basics of Nano Chemistry: Distinction between molecules, nanomaterials and bulk materials. Preparation of nanomaterials- laser ablation method and Chemical Vapour Deposition (CVD). Application of Nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES 9

Phase rule terms with examples. water system; Reduced phase rule Two component system: lead-silver system – Composites, Need, Constitution: Matrix materials, Applications and Reinforcement and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS & COMBUSTION 9

Fuels –Classification-Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, and 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. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

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: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CO 2: Apply the basic knowledge of Corrosion and various electrodes.

CO 3: Know the economically and new methods of synthesis nano materials.

CO 4: Apply the knowledge of phase rule and composites for material selection requirements.

CO 5: Understand the concepts of suitable fuels for engineering processes and applications.

CO 6: Have the knowledge of different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

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.
4. J. Manivel , "Engineering Chemistry" R.K.Publishers, 1st Edition 2022.

REFERENCE BOOKS:

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. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.

U23GET15	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING **9**

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Develop algorithmic solutions to simple computational problems
- **CO 2:** Develop and execute simple Python programs
- **CO 3:** Develop simple Python programs using conditionals and loops for solving problems
- **CO 4:** Explain the Concept of Lists and Tuples
- **CO 5:** Develop simple Python programs for Read and write data from/to files in Python programs
- **CO 6:** Explain the Concept of exceptions

TEXT BOOKS:

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:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, "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", Third Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands-on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.

GE3152	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

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, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

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: 15 PERIODS

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 Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3152 **தமிழர்மரபு** **L T P C**
1 0 0 1

அலகு I மொழி மற்றும் இலக்கியம்: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL: 15 PERIODS

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 Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

U23GEP13	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To understand the problem-solving approaches.
2. To learn the basic programming constructs in Python.
3. To practice various computing strategies for Python-based solutions to real world problems.
4. To use Python data structures - lists, tuples, dictionaries.
5. To do input/output with files in Python.
6. To understand the problem-solving approaches.

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment / Software	Quantity
1.	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2.	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3.	PyCharm / IDLE / Spyder /	30

COURSE OUTCOMES:

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

CO 1: Develop algorithmic solutions to simple computational problems.
CO 2: Develop and execute simple Python programs
CO 3: Develop real-time/technical applications using Sets, Dictionaries
CO 4: Build programs using Functions and Strings
CO 5: Construct Python program using Python Standard Libraries
CO 6: Develop real-time/technical applications using File handling and Exception handling

U23BSP11	PHYSICS AND CHEMISTRY LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L 0	T 0	P 4	C 2

COURSE OBJECTIVES

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

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.
6. To inculcate experimental skills to test basic understanding of water quality parameters, as, acidity, alkalinity, chloride.
7. To Induce the students to analyze the hardness of water
8. To induce the students to familiarize with electro analytical techniques such as, pH metry, conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular disc.
2. Non - Uniform bending–Determination of Young's modulus.
3. Laser – (i) Determination of the wavelength of the laser using grating.
   (ii) Determination of size of the particles using laser source.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor using PN junction kit.
6. To study the V-I Characteristics of Light Dependent Resistor (LDR).
7. Determination of types and amount of alkalinity in water sample.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Determination of chloride content of water sample by Argentometric method.
10. Determination of strength of given hydrochloric acid using pH meter.
11. Determination of strength of acids in a mixture of acids using conductivity meter.
12. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Name of the Equipment	Quantity
1.	Torsion pendulum set up (Metal Disc, Symmetrical Mass(2x100g), Stop Clock, Screw Gauge)	5
2.	Non – Uniform bending set up (Travelling Microscope, Knife Edges, Weight Hanger with Mass(5x50g), Screw Gauge, Vernier Caliper, Meter Scale)	5
3.	Laser set up (Semiconductor Laser, Screen, Grating Stand, Wooden Stand with Meter Scale)	5
4.	Air wedge (Air Wedge Set Up, Travelling Microscope, Sodium Vapour Lamp, Transformer)	5
5.	Band gap of a semiconductor (PN Junction Kit, Thermometer, Heater, Beaker, Oil)	5
6.	Light Dependent Resistor (Power Suppy, Voltmeter, Ammeter, LDR, Bulb, Resistors)	5
7.	PH meter	5
8.	Conductivity meter	10
9.	Common Apparatus (Pipette, Burette, Conical Flask, Porcelain tile, Dropper)	15

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the functioning of various physics laboratory equipment.

CO 2: Observe and tabulate experimental data.

CO 3: Solve problems individually and collaboratively.

CO 4: Analyze the quality of water samples with respect to their acidity, alkalinity

CO 5: Determine the amount of hardness in the water

CO 6: Analyze quantitatively the impurities in solution by electro analytical techniques

U23HSP12	ENGLISH LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L 0	T 0	P 2	C 1

COURSE OBJECTIVES

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

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

LIST OF EXPERIMENTS

1 Listening for general information-specific details.
2 Conversation: Introduction to classmates.
3 Speaking - making telephone calls-Self Introduction.
4 Talking about current and temporary situations & permanent and regular situations.
5 Listening to podcasts, anecdotes / stories / event narration.
6 Event narration; documentaries and interviews with celebrities.
7 Events-Talking about current and temporary situations & permanent and regular situations.
8 Engaging in small talk.
9 Describing requirements and abilities- Picture description.
10 Discussing and making plans.
11 Talking about tasks- progress- positions -directions of movement.
12 Talking about travel preparations and transportation.
13 Listening to debates/ discussions.
14 Making prediction talking about a given topic.
15 Describing processes.

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1
8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Identify and comprehend complex academic texts.

CO 2: Interpret accurately and fluently in formal and informal communicative contexts.

CO 3: Demonstrate their opinions effectively in both oral and written medium of communication.

CO 4: Plan travelogue and construct paragraphs on various aspects.

CO 5: Develop journal reading skills and small talk.

CO 6: Utilizing technical terms and making power point presentations.

SEMESTER-II

		L	T	P	C
U23HST21	**PROFESSIONAL ENGLISH (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES

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

1. To engage learners in meaningful language activities to improve their reading and writing skills.
2. To learn various reading strategies and apply in comprehending documents in professional context.
3. To help learners understand the purpose, audience, contexts of different types of writing.
4. To enable students write letters and reports effectively in formal and business situations.
5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I PREPARATORY DOCUMENTATIONS 6

Listening- Listening to formal conversations and Participating**. Speaking-** speaking about one's family. **Reading –** Summary of W.W Jacobs "The monkey's paw". **Writing –** Subject verb Agreement, Numerical -Adjectives, Kinds of sentences**,** Writing reviews (book / film),writing Instructions, Writing Recommendation.

UNIT II LECTURA ENRICHMENT AND PASSAGE COMPOSE 6

Listening- listening to lectures on academic topics; **Speaking-** Asking for and giving directions. **Reading -** Reading longer technical texts; **Writing -** Compound words, Homophones and Homonyms, Cause and Effect expressions. Essay Writing, Writing Letter to the Editor (complaint, acceptance, Requesting, Thanking).

UNIT III ANALYTICAL SKILL 6

Listening- Watching videos/documentaries and responding to questions based on them. **Speaking –** Speaking about ones favourite place**. Reading –** Summary of the poem – John keats "Ode to a Nightingale". **Writing-** Purpose statement, Extended Definitions. Writing Job/ Internship application – Cover letter & Resume.

UNIT IV REPORT WRITING 6

Listening- Listening to class room lectures/talks on engineering/technology. **Speaking–** Introduction to technical presentations. **Reading –** Newspaper articles; **Writing –** Comparative Adjectives Direct and Indirect speech**.** Report Writing- Fire Accident Report, Road Accident, Feasibility Report).

UNIT V ENABLING LINGUA IDEALITY & INFORMATION 6

Listening- TED/Ink talks. **Speaking –** Making presentation on a given topic. **Reading –**Company profiles, Statement of Purpose, (SOP), **Writing –** Relative Clauses, If conditions, Cause and Effect. Chart Interpretations - Bar Chart, Pie Chart, Flow Chart & Tables.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO 1: Compare and contrast products and ideas in technical texts.

CO 2: Identify cause and effects in events, industrial processes through technical texts.

CO 3: Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.

CO 4: Motivate students to write reports and winning job applications.

CO 5: Recall and comprehend different discourses and genres of texts.

CO 6: Making the students to become virtuous presenters.

TEXT BOOKS:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private 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:

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, New Delhi.
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.

U23MAT22	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

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

1. To understand the basic concepts of a few statistical tools and give procedures for solving different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of classifications of design of experiments in the field of agriculture.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. 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.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS **12**

Introduction – 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 **12**

Introduction – Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS **12**

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen Value of a matrices by power method and jacobi's method for Symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION **12**

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

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12**

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 Bashforth predictor corrector methods for solving first order differential equations.

TOTAL:60 PERIODS

COURSE OUTCOMES:

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

CO 1:	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO 2:	Apply the basic concepts of classifications of design of experiments in the field of agriculture.
CO 3:	Solve the algebraic and transcendental equations.
CO 4:	Understand the knowledge of numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
CO 5:	Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.
CO 6:	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS:

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 :

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.

U23PHT25	PHYSICS FOR INFORMATION SCIENCE (COMMON TO CSE, IT AND AI&DS PROGRAMMES)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make the students to understand the basics of crystallography and its importance in studying materials properties.
2. To instill knowledge on physics of semiconductors, determination of charge carriers and device applications.
3. To inculcate an idea of significance of new materials, nanostructures ensuing nano device applications.

UNIT I CONDENSED MATTER PHYSICS 9

Introduction - Lattice - Unit Cell - Seven Crystal Systems -Bravai's Lattices - Lattice Planes - Calculation of Number of Atoms per Unit Cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP Structures. Miller Indices – Derivation for Inter-Planar Spacing in terms of Miller Indices-Crystal Growth Techniques: Melt Growth Technique (Bridgman and Czochralski Techniques).

UNIT II PHYSICS OF SEMICONDUCTOR 9

Introduction – Properties - 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 – Carrier Transport in Semiconductors: Drift, Mobility and Diffusion – Hall Effect and Devices.

UNIT III MODERN ENGINEERING MATERIALS 9

Shape Memory Alloys – Structures – Properties – Applications. Metallic Glasses – Preparation and Applications. Ceramics – Types - Properties and Applications.

Nanomaterials – Types – Properties and Applications – Preparation Techniques: Electrodeposition – Pulsed Laser Deposition. CNT – Structure – Types – Properties - Applications

UNIT IV OPTOELECTRONICS AND DEVICES 9

Classification of optical materials-Light detectors and solor cells – Light emitting diode- Laser diode-optical process in organic semiconductor device-Excitonic state – Electro-optics and nonlinear optics; Modulator and Switching devices-plasmonics-Applications of opto electronics devices.

UNIT V DIELCTRIC MATERIALS 9

Fundamental definitions – polarization: types – polarizability calculation – frequency and temperature dependence of polarization – internal electric field and Clausius – Mosotti relation – dielectric breakdown: types, characteristics and remedies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Know basics of crystallography and its importance for varied materials properties.

CO 2: Acquire knowledge on basics of semiconductor physics and its applications in various devices.

CO 3: Illustrate the SMA and metallic glasses.

CO 4: Understand the optical properties of materials and working principles of various optical devices

CO 5: Explain types of polarization and its mathematical expression

CO 6: Classify the various types of dielectric breakdown based on materials

TEXT BOOKS:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
2. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.
3. Dr. P. Mani, "Physics for Electronics Engineering" Dhanam Publications, 2017.
4. Dr. G. Senthilkumar, "Engineering Physics II" VRB Publishers, 2013.
5. Theraja .B.L., Basic electronics solid state, S.Chand and Company Ltd (2002).

REFERENCE BOOKS:

1. R.Balasubramaniam, Callister's Materials Science and Engineering. Wiley (Indian Edition), 2014.
2. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006.
3. Dr. G. Senthilkumar, A. Ravikumar & S. Rajivgandhi, "Engineering Physics II", VRB Publishers, 2023.
4. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
5. Kasap.S.O"Principlesof Electronic materials and Devices.;McGraw-Hill education, 2007.
6. S. O. Pillai, "Solid State Physics", New Age International, New Delhi, 1995.

U23EET23	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the basics of electric circuits and analysis
2. To impart knowledge in the basics of working principles and application of electrical machines
3. To introduce analog devices and their characteristics
4. To educate on the fundamental concepts of digital electronics
5. 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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Compute the electric circuit parameters for simple problems
- **CO 2:** Explain the working principle of electrical machines
- **CO 3:** Explain the applications of electrical machines
- **CO 4:** Analyze the characteristics of analog electronic devices
- **CO 5:** Explain the basic concepts of digital electronics
- **CO 6:** Explain the operating principles of measuring instruments

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw 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, PuneetSawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCE BOOKS:

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

U23ECT23 DIGITAL PRINCIPLES AND SYSTEM DESIGN

L	T	P	C
3	1	0	4

COURSE OBJECTIVES

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

1. To design digital circuits using simplified Boolean functions
2. To analyze and design combinational circuits
3. To analyze and design synchronous and asynchronous sequential circuits
4. To understand Programmable Logic Devices
5. To write HDL code for combinational and sequential circuits

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 12

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

UNIT II COMBINATIONAL LOGIC 12

Combinational Circuits – Analysis and Design Procedures – Binary Adder – Subtractor – Decimal Adder– Magnitude Comparator– Decoders – Encoders – Multiplexers – Demultiplexer.

UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 12

Sequential circuits: Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables – Triggering of FF – Registers and Counters – Design of Counters – Ripple Counter – Ring Counters – Shift registers – Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 12

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race free State Assignment – Hazards – Essential Hazards– Design of Hazard free circuits.

UNIT V MEMORY AND PROGRAMMABLE LOGIC 12

RAM – Memory Decoding – Memory Expansion – ROM – PROM – EPROM – EEPROM – Programmable Logic Devices– Programmable Logic Array.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Simplify Boolean functions using KMap

CO 2: Design and Analyze Combinational and Synchronous Sequential Circuits.

CO 3: Design and analyze

CO 4: Write HDL code for combinational and Sequential Circuits

CO 5: Implement the different memory management.

CO 6: Implement designs using Programmable Logic Devices

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6th Edition, Pearson Education, 2017.
2. G. K. Kharate, "Digital Electronics", Oxford University Press, 2010

REFERENCE BOOKS:

1. John F. Wakerly, "Digital Design Principles and Practices", Fifth Edition, Pearson Education, 2017.
2. Charles H. Roth Jr, Larry L. Kinney, "Fundamentals of Logic Design", Sixth Edition, CENGAGE Learning, 2013
3. Donald D. Givone, "Digital Principles and Design", Tata Mc Graw Hill, 2003.

U23CST21	PROGRAMMING IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the constructs of C Language.
2. To develop C Programs using basic programming constructs
3. To develop C programs using arrays and strings
4. To develop modular applications in C using functions
5. To develop applications in C using pointers and structures

UNIT I BASICS OF C PROGRAMMING **9**

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process

UNIT II ARRAYS AND STRINGS **9**

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT III FUNCTIONS AND POINTERS **9**

Shape Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

UNIT IV STRUCTURES AND UNION **9**

Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

UNIT V FILE PROCESSING **9**

Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Demonstrate knowledge on C Programming constructs
CO 2: Design and implement applications using arrays and strings
CO 3: Develop and implement modular applications in C using functions and pointers
CO 4: Develop applications in C using structures and unions
CO 5: Design applications using sequential and random-access file processing.
CO 6: Explain the concept of Command line arguments

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2015.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018 .
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
5. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013.

GE3252	TAMILS AND TECHNOLOGY	L	T	P	C
		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)- Thirumalai Nayakar 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 Kumizhi Thoompu 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: 15 PERIODS

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 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.

GE3252	தமிழரும் தொழில்நுட்பமும்	L	T	P	C
		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

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 உற்பத்தித் தொழில் நுட்பம்: 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 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: 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 அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: 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: 15 PERIODS

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.)
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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.

U23CSP21	PROGRAMMING IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To familiarize with C programming constructs.
2. To develop programs in C using basic constructs.
3. To develop programs in C using arrays.
4. To develop applications in C using strings, pointers, functions.
5. To develop applications in C using structures.
6. To develop applications in C using file processing

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion.
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers.
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17” or higher TFT Monitor, Keyboard and mouse	30
2.	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3.	Dev C / Eclipse CDT / Code Blocks / CodeLite / equivalent open source IDE	30

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Demonstrate knowledge on C programming constructs.
- **CO 2:** Develop programs in C using basic constructs
- **CO 3:** Construct programs in C using arrays.
- **CO 4:** Develop applications in C using strings, pointers, functions
- **CO 5:** Build applications in C using structures.
- **CO 6:** Develop applications in C using file processing

U23HSP22	COMMUNICATION LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L 0	T 0	P 4	C 2

COURSE OBJECTIVES:

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

1. To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
2. To be able to communicate effectively through writing.
3. Encouraging plan designing and decision making.
4. Understanding and writing technical instruction.
5. To understand the value of letter writing with correct format.

LIST OF EXPERIMENTS:

1. Speaking-Role Play Exercises Based on Workplace Contexts.
2. Talking about competition.
3. Discussing progress toward goals-talking about experiences.
4. Discussing likes and dislikes.
5. Discussing feelings about experiences.
6. Discussing imaginary scenarios.
7. Writing short essays.
8. Speaking about the natural environment.
9. Describing communication system.
10. Describing position and movement- explaining rules.
11. Understanding technical instructions-Writing: writing instructions.
12. Speaking: describing things relatively-describing clothing.
13. Discussing safety issues (making recommendations) talking about electrical devices.
14. Describing controlling actions.
15. Writing a job application (Cover letter + Resume).

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	30
2.	Server	1
3.	Head phone	30
4.	Audio mixture	1
5.	Collar mike	1
6.	Television	1
7.	Speaker set with amplifier	1
8.	Power point projector and screen	1
9.	Cordless mike	1

COURSE OUTCOMES:

At the end of the course the students would be able to:

- **CO 1:** Distinguish their technical competency through language skill.
- **CO 2:** Predict context effectively in-group discussions held in a formal / semi-formal discussion.
- **CO 3:** Understanding candidates' key characteristics.
- **CO 4:** Finding personality traits by sharing and comparing thoughts and ability.
- **CO 5:** Understanding the value of ethics. (Rules and regulations).
- **CO 6:** Construct emails and effective job applications**.**

SEMESTER – III

		L	T	P	C
U23AIT31	**DATABASE MANAGEMENT SYSTEMS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. To introduce database development life cycle and conceptual modeling
2. To learn SQL for data definition, manipulation and querying a database
3. To learn relational database design using conceptual mapping and normalization
4. To learn transaction concepts and serializability of schedules
5. To learn data model and querying in object-relational and No-SQL databases

UNIT I CONCEPTUAL DATA MODELING **8**

Database environment – Database system development lifecycle – Requirement's collection – Database design -- Entity-Relationship model – Enhanced-ER model – UML class diagrams

UNIT II RELATIONAL MODEL AND SQL **10**

Relational model concepts -- Integrity constraints -- SQL Data manipulation – SQL Data definition – 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 (upto BCNF).

UNIT IV TRANSACTION MANAGEMENT **8**

Transaction concepts – properties – Schedules – Serializability – Concurrency Control – Two- phase locking techniques.

UNIT V OBJECT RELATIONAL AND NO-SQL DATABASES **9**

Mapping EER to ODB schema – Object identifier – reference types – row types – UDTs – Subtypes and super types – user-defined routines – Collection types – Object Query Language; No-SQL: CAP theorem – Document-based: MongoDB data model and CRUD operations; Column-based: H base data model and CRUD operations

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the database development life cycle and apply conceptual modelling

CO 2: Apply SQL and programming in SQL to create, manipulate and query the database

CO 3: Apply the conceptual-to-relational mapping and normalization to design relational database

CO 4: Determine the serializability of any non-serial schedule using concurrency techniques

CO 5: Apply the data model and querying in Object-relational and No-SQL databases

CO 6: Apply the H base data model and CRUD Operations in NO SQL

TEXT BOOKS:

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 Database Systems, 7th Edition, Pearson, 2017.

REFERENCE BOOKS:

1. Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, "DATABASE MODELING 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, S Sudharshan, "Database System Concepts", 6th Edition, Tata Mc Graw Hill, 2011.
4. Hector Garcia-Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems: The Complete Book", 2nd edition, Pearson.
5. Raghu Ramakrishnan, "Database Management Systems", 4th Edition, Tata Mc Graw Hill, 2010

U23AIT32	DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the concepts of ADTs
2. To Learn linear data structures – lists, stacks, and queues
3. To understand sorting, searching and hashing algorithms
4. To apply Tree and Graph structures
5. To learn the Concept of Hashing Techniques

UNIT I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists – applications of lists.

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue – de Queue – applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Graphs: Representation – Graph traversals – Breadth-first traversal - Depth-first traversal – Topological ordering - Minimum spanning trees: Prim's algorithm, Kruskal's algorithm – Shortest path algorithms: Dijkstra's algorithm- Floyd Warshall algorithm – Applications of Graphs

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort – merge sort – quick sort. Hashing- Hash Functions – Collision handling- Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Explain linear data structures using array and linked list.
- **CO 2:** Understand the concept of stacks & queues.
- **CO 3:** Explain non-linear data structures of tree traversal.
- **CO 4:** Understand Breadth-first traversal and Depth-first traversal.
- **CO 5:** Apply Searching and sorting techniques in data structures.
- **CO 6:** Apply hashing techniques in data structures

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2005.
2. Kamthane, "Introduction to Data Structures in C", 1st Edition, Pearson Education, 2007

REFERENCE BOOKS:

1. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2015.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, Mcgraw Hill/ MIT Press, 2022
3. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft, "Data Structures and Algorithms", 1st edition, Pearson, 2002.
4. Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2006.

U23AIT33	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To make students understand the basic structure and operation of digital computer.
2. To understand the hardware-software interface.
3. To familiarize the students with arithmetic and logic unit and implementation of fixed point and floating-point arithmetic operations.
4. To familiarize the students with hierarchical memory system including cache memories and Virtual memory.

UNIT I OVERVIEW & INSTRUCTIONS 9

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

UNIT II ARITHMETIC OPERATIONS 9

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations – Sub word Parallelism.

UNIT III PROCESSOR AND CONTROL UNIT 9

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

UNIT IV PARALLELISM 9

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

UNIT V MEMORY AND I/O SYSTEMS 9

Memory hierarchy - Memory technologies – Cache basics – Measuring and improving cache performance - Virtual memory, TLBs - Input/output system, programmed I/O, DMA and interrupts, I/O processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the basics structure of computers, operations and instructions
CO 2: Explain the design concepts of arithmetic and logic unit
CO 3: Apply pipelined control units and the different types of hazards in the instructions
CO 4: Interpret the concepts of parallel processing architectures
CO 5: Summarize the fundamentals of memory system
CO 6: Explain the concepts of I/O system

TEXT BOOKS:

1. David A. Patterson and John L. Hennessey, “Computer organization and design, MorganKauffman Elsevier, Fifth edition, 2014.
2. Structured Computer Organization, Andrew S.Tanenbaum “Structured Computer Organization”sixth Edition 2021.

REFERENCE BOOKS:

1. Carl Hamacher. V, Zvonko G. Varanesic and Safat G. Zaky, “Computer Organization “, 6th edition,Mc Graw-Hill Inc, 2012.
2. William Stallings “Computer Organization and Architecture”, 11th Edition, Pearson Education, 2006.
3. Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, 2nd Edition, PearsonEducation, 2005.
4 Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications",1st edition, Tata McGraw Hill, New Delhi, 2005.

U23AIT34	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

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

1. Analyze the algorithms that are used to solve various problems.
2. Generate and solve the recurrences for divide and conquer techniques.
3. Solve the problems using greedy and dynamic programming paradigms.
4. Design the algorithms for solving the backtracking and transform and conquer methodologies.
5. Apply the branch and bound technique to solve various

UNIT I FUNDAMENTALS OF ALGORITHM ANALYSIS 12

Introduction - Problem solving techniques-Analysis framework – Time space tradeoff – Asymptotic notations – Conditional asymptotic notation – Properties of Big-Oh notation – Recurrence equations – Mathematical Analysis of Non-recursive algorithms - Mathematical analysis of recursive Algorithms – Analysis of linear search - Empirical analysis - Algorithm visualization

UNIT II BRUTE FORCE AND DIVIDE AND CONQUER STRATEGIES 12

Brute Force: Selection Sort - Bubble Sort – String matching - Exhaustive Search: Travelling Sales-man problem - Divide and Conquer: General Method – Binary Search – Closest-pair problem – Merge Sort-Quick Sort.

UNIT III GREEDY AND DYNAMIC PROGRAMMING PARADIGMS 12

Greedy Algorithms: General Method – Container Loading – Huffman code – Knapsack problem - Dynamic Programming: General Method – Multistage Graphs – Optimal binary search trees– Knapsack problem

UNIT IV BACKTRACKING AND TRANSFORM AND CONQUER METHODOLOGIES 12

Backtracking: General Method – N-Queen's problem – Sum of subsets – Graph coloring – Hamiltonian problem. Transform and conquer: Presorting – Gaussian elimination.

UNIT V GRAPH, BRANCH AND BOUND STRATEGIES 12

Graph : Connected Components – Bi-connected components – Branch and Bound: General Method (FIFO and LC) – Job assignment problem - 0/1 Knapsack problem – Introduction to NP-Hard and NP-Completeness

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO 1: Classify the fundamentals of Algorithmic problem-solving methods based on Data Structures.

CO 2: Analyze the algorithm efficiency by means of mathematical notations

CO 3: Develop different types of sorting and searching algorithms

CO 4: Analyze the different techniques in the design of Graph Algorithms

CO 5: Apply the Concept of Branch and bound Problems

CO 6: Differentiate algorithms design techniques of NP complete with NP hard problems

TEXT BOOKS:

1. T. H. Cormen, C. E. Leiserson, R.L.Rivest, and C. Stein, "Introduction to Algorithms", Third Edition, Prentice Hall of India Pvt. Ltd, 2009.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "The Design and Analysis of Computer Algorithms", Pearson Education, 1999.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, “Computer Algorithms C++”, Second Edition, Universities Press, 2008.

REFERENCE BOOKS:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein,
2. “Introduction to Algorithms”, Third Edition, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
4. Harsh Bhasin, “Algorithms Design and Analysis”, Oxford university press, 2015.

U23AIT35	DESIGN THINKING FOR AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the process of Design Thinking
2. To explore the analysis and experiment various methods and tools
3. To understand the concept synthesis and strategic requirements
4. To visualize the process of Journey mapping
5. To adopt Artificial Intelligence in the process of Design Thinking

UNIT I PRINCIPLES OF DESIGN THINKING 9

Principles of Design Thinking- Process of Design Thinking – Planning a Design Thinking project- Understanding of the problem - Observation Phase - Point-of-View Phase - Ideate Phase - Prototype Phase - Test Phase – Implementation

UNIT II EXPLORE, EMPATHIZE AND EXPERIMENT PHASES 9

Explore phase-STEEP Analysis, Strategic priorities, Activity System, Stakeholder Mapping, Opportunity Framing-Empathize - Methods & Tools, Field observation, Deep user interview, Needs Finding, Persona Development Experiment-Methods & Tools, Ideation using Scamper, Analogous Inspiration, Deconstruct & Reconstruct, User Experience Design, Prototyping

UNIT III ENGAGE AND EVOLVE PHASE 9

Engage-Methods & Tools, Storytelling, Storyboarding, co-creation -Evolve- Methods & Tools, Concept Synthesis, Strategic requirements, Activity system integration, viability analysis, Innovation Tool (Using User needs, CAP,4S), Change management tool using review, Quick wins, Art of Story telling

UNIT IV VISUALIZATION 9

Visualization-Journey Mapping-Value chain analysis-Mind Mapping-Brainstorming-Concept Development- Assumption Testing-Rapid prototyping-customer co-creation-Learning Launch- Leading growth and innovation in an organization

UNIT V ADOPTION OF ARTIFICIAL INTELLIGENCE 9

Introduction to the adoption of Artificial Intelligence-Design and its operating context-AI empowered design in practice-Design for Artificial Intelligence-Implications for Innovation and Design Theories

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to,

CO 1: Plan a Design Thinking project
CO 2: Empathize and experiment the methods and tools
CO 3: Understand the strategic requirements
CO 4: Appreciate the concept development
CO 5: Appreciate the adoption of Artificial Intelligence
CO 6: Create the Innovations in Design Theories

TEXT BOOKS:

1. Müller-Roterberg, Christian. (2018). "Handbook of Design Thinking".
2. Design Thinking the Guide Book

REFERENCE BOOKS:

1. Tim Brown, Barry Katz," Change by Design - How Design Thinking Transforms Organizations and Inspires Innovation", First Edition, HapperCollins,2009
2. Thomas Lockwood, "Design Thinking – Integrating, Innovation, Customer experience and Brand value", First Edition, Allworth Press, 2009
3. Jeanne Liedtka and Tim Ogilvie.(2011), "Designing for Growth: a design thinking tool kit for managers".
4. Roberto Verganti,Luca Vendraminelli,Marco Iansiti.(2020). "Innovation and Design in the Age of Artificial Intelligence", Volume 37,Issue 3.

U23AIP31 DATABASE MANAGEMENT SYSTEMS LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

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

1. To understand the database development life cycle
2. To learn database design using conceptual modeling, Normalization
3. To implement database using Data definition, Querying using SQL manipulation and SQL programming.
4. To implement database applications using IDE/RAD tools
5. 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
6. Stored Procedures/Functions Constraints and security using Triggers
7. Database design using Normalization – bottom-up approach
8. Develop database applications using IDE/RAD tools (Eg., Net Beans, Visual Studio)
9. Database design using EER-to-ODB mapping / UML class diagrams
10. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
11. Querying the Object-relational database using Object Query language

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop	**30**
2.	PostgreSQL	**30**

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1:	Understand the database development life cycle
CO 2:	Design relational database using conceptual-to-relational mapping, Normalization
CO 3:	Apply SQL for creation, manipulation and retrieval of data
CO 4:	Develop a database application for real-time problems
CO 5:	Design the object-relational databases
CO 6:	Apply the O-R database to create different queries

U23AIP32	DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To implement ADTs in Python
2. To design and implement linear data structures – lists, stacks, and queues
3. To implement sorting, searching and hashing algorithms
4. To solve problems using tree and graph structures
5. To implement Shortest Path and Minimum Spanning Tree.

LIST OF EXPERIMENTS

1. Implement simple ADTs as Python classes
2. Implement recursive algorithms in Python
3. Implement List ADT using Python arrays
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: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop	**30**
2.	Python IDLE	**30**
3.	Turboc	**30**

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Implement ADTs as Python classes

CO 2: Design, implement, and analyze linear data structures, such as lists, queues, and stacks, according to the needs of different applications

CO 3: Design, implement, and analyze efficient tree structures to meet requirements such as searching, indexing, and sorting

CO 4: Model problems as graph problems and implement efficient graph algorithms to solve them

CO 5: Implement the different shortest path algorithms like Dijkstrats and Floyd warshall algorithms.

CO 6: Implement the different Minimum Spanning tree algorithms like Prims and Kruskals algorithm

SEMESTER – IV

		L	T	P	C
U23MAT41	**PROBABILITY AND STATISTICS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

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

1. To introduce the basic concepts of probability and random variables.
2. To introduce the basic concepts of two-dimensional random variables.
3. This course aims at providing the required skill to apply the statistical tools in engineering problems.
4. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
5. To introduce the basic concepts of classifications of chart in statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions – Functions of a random variable.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III ESTIMATION THEORY 12

Unbiased estimators – Efficiency - Consistency – Sufficiency -Robustness - Method of moments – Method of maximum Likelihood - Interval estimation of Means – Differences between means, variations and ratio of two variances.

UNIT IV NON - PARAMETRIC TESTS 12

Introduction - The Sign test - The Signed - 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 12

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

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO 1:	Understand the fundamental knowledge of the concepts of probability and have Knowledge of standard distributions which can describe real life phenomenon.
CO 2:	Understand the basic concepts of two-dimensional random variables and apply in engineering applications.
CO 3:	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO 4:	Apply the basic concepts of testing of hypothesis for small and large samples
CO 5:	Have the notion of sampling distributions and statistical quality control techniques used in engineering and management problems
CO 6:	Understand the knowledge of correlation and Regression for distributed random variables.

TEXT BOOKS:

1. Johnson. R.A., Miller. I.R and Freund. 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 Graw Hill, 4th Edition , 2007.
3. John E. Freund , "Mathematical Statistics" , Prentice Hall, 5th Edition ,1992.

REFERENCES BOOKS:

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 sciences", Cengage Learning, New Delhi, 8th Edition , 2014.
3. Ross. S.M and the Sciences ., "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.

U23AIT41	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Learn the basic AI approaches
2. Develop problem solving agents
3. Perform logical reasoning
4. Perform probabilistic reasoning
5. Learn the Bayesian networks

UNIT I INTELLIGENT AGENTS 9

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms –uninformed search strategies.

UNIT II PROBLEM SOLVING 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: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain intelligent agent frameworks
CO 2: Apply problem solving techniques
CO 3: Apply game playing and CSP techniques
CO 4: Perform logical reasoning.
CO 5: Perform probabilistic reasoning under uncertainty.
CO 6: Apply the rules to obtain the Inference

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021
2. Bratko, "Prolog: "Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCE BOOKS:

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.

U23AIT42	DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the techniques and processes of data science
2. To apply descriptive data analytics
3. To visualize data for various applications
4. To understand inferential data analytics
5. 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 r^2 – multiple regression equations – regression towards 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 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 – auto correlation. Introduction to survival analysis.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand the real-world data and information
CO 2: Apply data science using excel & Python
CO 3: Design of mathematical model for problem solving
CO 4: Interpret various tools and its advantages
CO 5: Illustrate the different opportunities in industries
CO 6: Apply data modelling for real-world applications

TEXT BOOKS:

1. Chirag Shah, "A Hands-on Introduction to Data Science", Cambridge University Press, 2020.
2. Sinan Ozdemir, "Principles of Data Science", Packt Publication, 2016.
3. Julio Cesar Rodriguez Martino, "Hands-on Machine Learning with Microsoft Excel", Packt Publication, 2019.

REFERENCE BOOKS:

1. Hector Guerrero, "Excel Data Analysis: Modelling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W McOwan, "The Power of Computational Thinking", World Scientific Publishing, 2017
3. Steven S Skiena, "Data Science Design Manual", Spring International Publication, 2017.
4. Rajendra Akekar, Priti Srinivas Sajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.

U23CST43	OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics and functions of operating systems.
2. To understand Processes and Threads
3. To analyze Scheduling algorithms and process synchronization.
4. To understand the concept of Deadlocks.
5. To analyze various memory management schemes
6. To be familiar with I/O management and File systems.
7. To be familiar with the basics of virtual machines and Mobile OS like iOS and Android**.**

UNIT I INTRODUCTION **9**

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface – System Calls – System Programs – Design and Implementation – Structuring methods

UNIT II PROCESS MANAGEMENT **9**

Processes – Process Concept – Process Scheduling – Operations on Processes – Inter-process Communication; CPU Scheduling – Scheduling criteria – Scheduling algorithms: Threads – Multithread Models – Threading issues; Process Synchronization – The Critical-Section problem – Synchronization hardware – Semaphores – Mutex – Classical problems of synchronization – Monitors; Deadlock – Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock

UNIT III MEMORY MANAGEMENT **9**

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation, Segmentation with paging; Virtual Memory – Demand Paging – Copy on Write – Page Replacement – Allocation of Frames –Thrashing.

UNIT IV STORAGE MANAGEMENT **9**

Mass Storage system – Disk Structure – Disk Scheduling and Management; File-System Interface – File concept – Access methods - Directory Structure - Directory organization - File system mounting - File Sharing and Protection; File System Implementation – File System Structure – Directory implementation – Allocation Methods – Free Space Management; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem.

UNIT V VIRTUAL MACHINES AND MOBILE OS **9**

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS – IoS and Android.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the overall view of the computer system and operating system.
CO 2: Analyze various scheduling algorithms and process synchronization
CO 3: Compare and contrast various memory management schemes
CO 4: Explain the functionality of file systems and I/O systems
CO 5: Compare ioS and Android Operating Systems.
CO 6: Explain the concept of Virtual Machines

TEXT BOOKS:

1. Ramaz Elmasri, A. Gil Carrick, David Levine," Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010
2. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.

REFERENCE BOOKS:

1. Achyut S Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
2. Andrew S Tanenbaum, "Modern Operating Systems", 2nd Edition, Pearson Education, 2004.
3. Harvey M Deitel, "Operating Systems", 3rd Edition, Pearson Education, 2004
4. Daniel P Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd edition, O'Reilly, 2005.

U23AIT44	FUNDAMENTALS OF COMPUTER NETWORKS AND COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the protocol layering and physical level communication
2. To analyze the performance of a network
3. To visualize the end-to-end flow of information
4. To learn the functions of network layer and the various routing protocols
5. To familiarize the functions and protocols of the Transport layer

UNIT I INTRODUCTION AND PHYSICAL LAYER **9**

Networks–Network Types–Protocol Layering–TCP/IP Protocol suite–OSI Model – Physical Layer: Performance–Transmission media – Switching – Circuit–switched Networks – Packet Switching

UNIT II DATA-LINK LAYER & MEDIA ACCESS **9**

Introduction–Link-Layer Addressing–DLC Services–Data-Link Layer Protocols–HDLC – PPP Media Access Control –Wired LANs: Ethernet-Wireless LANs–Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

UNIT III NETWORK LAYER **9**

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol-ARP, RARP, DHCP

UNIT IV TRANSPORT LAYER **9**

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol - Congestion Control – SCTP

UNIT V APPLICATION LAYER **9**

WWW and HTTP–FTP–Email–Telnet–SSH –DNS–SNMP

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basic layers and its functions in computer networks
CO2: Evaluate the performance of a network
CO3: Understand the basics of how data flows from one node to another
CO4: Analyze and design routing algorithms
CO5: Design protocols for various functions in the network
CO6: Understand the working of various application layer protocols

TEXT BOOKS:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Eighth Edition, Pearson Education, 2021.

REFERENCE BOOKS:

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 and Fred Baker, Computer Networks: An Open-Source Approach, McGraw Hill Publisher, 2011.

U23GET41	ENVIRONMENTAL SCIENCES AND ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

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

1. To the study of nature and the facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the interrelationship between living organism and environment.
4. To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value.
5. To study the integrated themes and biodiversity, natural resources, pollution control and waste Management.

UNIT I ENVIRONMENT AND BIODIVERSITY **9**

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 **9**

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 RENEWABLE SOURCES OF ENERGY **9**

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV ENVIRONMENTAL ISSUES **9**

Social Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Population growth, variation among nations population explosion – family welfare programme – human rights – value education – HIV / AIDS – women and child welfare

UNIT V SUSTAINABILITY PRACTICES **9**

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.
- **CO 2:** Discover knowledge in ecological perspective and value of environment
- **CO 3:** Categorize different types of pollutions and their control measures.
- **CO 4:** Understand the significance of various natural resources and its management.
- **CO 5:** Analyze global environmental problems and come out with best possible solutions.
- **CO 6:** Understand environmental laws and sustainable development.

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata Mc Graw-Hill, New Delhi,2016
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004
3. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media. 38th edition 2010
4. J. Manivel and A. Arunkumar, "Environmental Science & Engineering" R.K. Publishers, 1st Edition 2023

REFERENCE BOOKS:

1. Dharmendra S. Sengar, "Environmental law", Prentice Hall of India PVT. LTD, New Delhi, 2007.
2. Rajagopalan, R, "Environmental Studies-From Crisis to Cure ", Oxford University Press, Third Edition,2015.
3. Erach Bharucha, "Text book of Environmental Studies" for Undergraduate Courses Orient Blackswan Pvt.Ltd. 2013.

U23AIP41	ARTIFICIAL INTELLIGENCE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To design and implement search strategies
2. To implement game playing techniques
3. To implement CSP techniques
4. To develop systems with logical reasoning
5. To develop systems with probabilistic reasoning

LIST OF EXPERIMENTS:

1. Implement basic search strategies – 8-Puzzle, 8 - Queens problem, Cryptarithmetic.
2. Implement A* and memory bounded A* algorithms
3. Implement Minimax algorithm for game playing (Alpha-Beta pruning)
4. Solve constraint satisfaction problems
5. Implement propositional model checking algorithms
6. Implement forward chaining, backward chaining, and resolution strategies
7. Build naïve Bayes models
8. Implement Bayesian networks and perform inferences
9. Mini-Project

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No.	Name of Equipment	Quantity
1.	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17” or higher TFT Monitor, Keyboard and mouse	30
2.	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3.	Python, Numpy, Scipy, Matplotlib, Pandas, seaborn	5
4.	Python3.9 and above	30

COURSE OUTCOMES:

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

- **CO 1**: Implement fundamental search strategies to solve AI problems.
- **CO 2**: Apply A* algorithms to efficiently navigate large state spaces using heuristic search techniques.
- **CO 3**: Develop game-playing agents to optimize decision-making in adversarial environments.
- **CO 4**: Implement constraint satisfaction problems (CSP).
- **CO 5**: Implement logical reasoning strategies for automated inference.
- **CO 6**: Construct probabilistic models to handle uncertainty in AI applications.

U23AIP42	DATA SCIENCE LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To understand the techniques and processes of data science
2. To apply descriptive data analytics
3. To visualize data for various applications
4. To understand inferential data analytics
5. To analysis and build predictive models from data

LIST OF EXPERIMENTS

1. Study of Basic function in Excel
2. Study of Basic Data Science Libraries in Python
3. Working with Range Names and Tables
4. Cleaning Data with Text Functions
5. Cleaning Data containing Data Values
6. Working with VLOOKUP functions and Pivot Table.
7. Demonstration of Data Visualization in Excel.
8. Demonstration of Data Visualization in Python.
9. Importing Data from External Source Using Excel & Python
10. Creating a data model
11. Create a dashboard for a given requirement
12. Implement a data analytics for the real time data set

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Standalone Desktop	30
2.	Microsoft Excel	30
3.	Python 3	30

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand the real-world data and information.
- **CO 2:** Apply data science using excel & Python.
- **CO 3:** Design of mathematical model for problem solving
- **CO 4:** Interpret various tools and its advantages.
- **CO 5:** Illustrate the different opportunities in industries.
- **CO 6:** Apply data modelling for real-world applications.

SEMESTER V

U23CST42	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Study about uninformed and Heuristic search techniques.
2. Learn techniques for reasoning under uncertainty
3. Introduce Machine Learning and supervised learning algorithms
4. Study about ensemble and unsupervised learning algorithms
5. Learn the basics of deep learning using neural networks
6. To understand Undecidability and NP class problems.

UNIT I PROBLEM SOLVING **9**

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT II 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.

UNIT III SUPERVISED LEARNING **9**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random forests

UNIT IV ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization

UNIT V NEURAL NETWORKS **9**

Perception - Multilayer perception, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyper parameter tuning, batch normalization, regularization, dropout.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Make Use of appropriate search algorithms for problem solving
CO 2: Apply reasoning under uncertainty
CO 3: Build supervised learning models
CO 4: Build ensemble and unsupervised models
CO 5: Build deep learning neural network models
CO 6: Explain gradient descent optimization

TEXT BOOKS:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition,1997.
2. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014

REFERENCE BOOKS:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
2. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education,2007
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016

U23AIT52	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To know the fundamental concepts of big data and analytics.
2. To explore tools and practices for working with big data.
3. To learn about stream computing.
4. To know about the research that requires the integration of large amounts of data

UNIT-I INTRODUCTION TO BIG DATA 9

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics – Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage – A General Overview of High-Performance Architecture - HDFS - MapReduce and YARN – Map Reduce Programming Model

UNIT-II CLUSTERING AND CLASSIFICATION 9

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions.- Classification: Decision Trees - Overview of a Decision Tree – The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes‘ Theorem - Naïve Bayes Classifier

UNIT-III ASSOCIATION AND RECOMMENDATION SYSTEM 9

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid Recommendation Approaches

UNIT-IV STREAM MEMORY 9

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window.

UNIT-V NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9

NoSQL Databases: Schema-less Models‖: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Learners are able to

CO 1: Work with big data tools and its analysis techniques

CO 2: Analyze data by utilizing clustering and classification algorithms

CO 3: Learn and apply different mining algorithms and recommendation systems for large volumes of data

CO 4: Perform analytics on data streams

CO 5: Learn NoSQL databases and management

CO 6: Evaluate ethical considerations and implications related to big data usage and analytics.

TEXT BOOKS:

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/ Elsevier Publishers, 2013.

REFERENCE BOOKS:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.
4. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
5. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce".
6. Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.

U23AIT53	DATA EXPLORATION AND VISUALIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To analyze diverse real-world data to extract data insights and interpret results.
2. To learn and apply exploratory data science techniques.
3. To learn grouping and aggregation with Pandas.
4. To work effectively to communicate findings, using Python.
5. To understand the Python for effective problem-solving.

UNIT I CREATING AND MANIPULATING NUMPY ARRAYS 9

Creating arrays, indexing and slicing, mathematical operations with NumPy arrays

UNIT II DATA MANIPULATION WITH PANDAS 9

Series and Data Frame objects; importing and exporting data from various file formats into pandas Data Frame; Data selection and filtering indexing, slicing, conditional filtering using boolean indexing

UNIT III GROUPING AND AGGREGATION WITH PANDAS 9

Grouping data using Pandas, applying aggregation functions such as sum, mean, count, etc.to grouped data, using pivot tables and cross-tabulation for data summarization

UNIT IV DATA VISUALIZATION WITH MATPLOTLIB AND SEABORN 9

Introduction to Matplotlib and Seaborn to plot data using figures and subplots, Plots - Line plots, scatter plots, and bar plots, visualizing distributions using histogram and box plots, Customizing plot aesthetics and adding annotations

UNIT V NOSQLDATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9

Introduction to Plotly library for interactive visualization; Creating interactive line plots, scatter plots, and bar plots; Adding interactivity with hover effects, zooming, and panning

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO 1: Create and manipulate NumPy arrays to perform data analysis.

CO 2: Use Pandas methods to import, export, and preprocess data from various sources.

CO 3: Perform basic data manipulation tasks, including data cleaning, filtering, sorting, and merging on Pandas objects.

CO 4: Use grouping and aggregation operations in Pandas to summarize data in Series and Data Frame objects.

CO 5: Analyze and interpret data based on grouped and aggregated results.

CO 6: Use Matplotlib and Seaborn to create static visualizations and plot to create interactive visualizations of data to communicate data insights.

TEXT BOOKS:

1. VanderPlas, J. “Python data science handbook: Essential tools for working with data”. O'Reilly Media, Inc.", 2nd edition.
2. McKinney W. “Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython”. 2nd edition. O’Reilly Media, 2018.
3. Molin S. Hands-On Data Analysis with Pandas, Packt Publishing, 2019.
4. Rahman K. “Python Data Visualization Essentials Guide: Become a Data Visualization expert by building strong proficiency in Pandas”, Matplotlib, Seaborn, Plotly, Numpy, and Bokeh, BPB 2021.

REFERENCE BOOK:

1. Chen D. Y, “Pandas for Everyone: Python Data Analysis”, Pearson, 2018. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.

U23CSP42	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To understand the python libraries for data science
2. To understand the basic Statistical and Probability measures for data science.
3. To learn descriptive analytics on the benchmark data sets.
4. To apply correlation and regression analytics on standard data sets.
5. To present and interpret data using visualization packages in Python.
6. Students will develop the ability to build and assess data-based models.

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl No	Name of the Equipment / Software	Quantity
1.	INTEL based desktop PC with min. 8GB RAM and 500 GB HDD, 17" or higher TFT Monitor, Keyboard and mouse	30
2.	Windows 10 or higher operating system / Linux Ubuntu 20 or higher	30
3.	Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh	
4.	Python 3.9 or later, Anaconda Distribution, python editors, Jupyter / PyCharm/equivalent	

COURSE OUTCOMES:

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

- **CO 1:** Understand the implementation procedures for the machine learning algorithms.
- **CO 2:** Design Java/Python programs for various Learning algorithms
- **CO 3:** Apply appropriate data sets to the Machine Learning algorithms
- **CO 4:** Apply Machine Learning algorithms to solve real world problems
- **CO 5:** Apply k-Nearest Neighbor algorithm to classify the iris data set.
- **CO 6:** Apply non-parametric Locally Weighted Regression algorithm

U23AIP52	BIG DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To implement Map Reduce programs for processing big data.
2. To realize storage of big data using MongoDB.
3. To analyze big data using machine learning techniques such as Decision tree classification and clustering.

LIST OF EXPERIMENTS

1. Install, configure and run python, numPy and Pandas.
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
5. Implement word count / frequency programs using MapReduce.
6. Implement a MapReduce program that processes a dataset.
7. Implement clustering techniques using SPARK.
8. Implement an application that stores big data in MongoDB / Pig using Hadoop / R

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl No.	Name of the Equipment	Quantity
1.	High-performance Desktop Computers / Laptops	30
2.	Hadoop Cluster (Master Node + Worker Nodes)	5-10 nodes
3.	Python 3	30
4.	GPU-enabled Workstations	5

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Process big data using Hadoop framework

CO 2: Build and apply linear and logistic regression models.

CO 3: Perform data analysis with machine learning methods.

CO 4: Apply various NoSQL database operations.

CO 5: Build applications using MongoDB.

CO 6: Develop applications using clustering techniques.

SEMESTER VI

U23AIT61	IOT AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. Identify the various IoT elements appropriate to the applications
2. Design a portable IoT using Arduino/Raspberry Pi incorporating cloud and analytics.
3. Implement IoT applications for real-time environment

UNIT I FUNDAMENTALS OF IoT **9**

Introduction - Definition and Characteristics of IoT - Physical design - IoT Protocols - Logical design - IoT communication models, IoT Communication APIs - Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs - IoT Architectural view

UNIT II ELEMENTS OF IoT **9**

IoT and M2M- difference between IoT and M2M - Software Defined Networks - Network Function Virtualization - IoT systems management – Needs - NETCONF, YANG - IoT design methodology

UNIT III IOT PROTOCOLS **9**

Sensors and actuators - Communication modules – Zigbee - LoRa - RFID - Wi-Fi - Power sources

UNIT IV BUILDING IoT WITH CLOUD AND DATA ANALYTICS **9**

IoT platforms – Arduino – Raspberry Pi - Cloud Computing in IoT - Cloud Connectivity - Big Data Analytics - Data Visualization

UNIT V CHALLENGES IN IOT AND CASE STUDIES **9**

Security Concerns and Challenges - Real time applications of IoT – Home automation – Automatic lighting – Home intrusion detection – Cities – Smart parking – Environment – Weather monitoring system – Agriculture – Smart irrigation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to :

- **CO 1:** Describe the characteristics, physical and logical designs, domains and architecture
- **CO 2:** Differentiate M2M and IoT, SDN and NFV design methodologies
- **CO 3:** Use of Devices, Gateways and Data Management in IoT
- **CO 4:** Design IoT applications in different domain and be able to analyze their performance
- **CO 5:** Implement basic IoT applications on embedded platform.
- **CO 6:** Implementing real-time applications of IoT

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things-A hands-on approach", Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things: Key applications and Protocols”, Wiley Publications 2nd edition, 2013

REFERENCE BOOKS:

1. Raj Kamal, “Internet of Things Architecture and Design Principles”, Mc Graw Hill Education Pvt. Ltd., 2017 2.
2. Internet of Things and Data Analytics, Hwaiyu Geng, P.E, Wiley Publications, 2017
3. Manoel Carlos Ramon, Intel® Galileo and Intel® Galileo Gen 2: “API Features and Arduino Projects for Linux Programmers”, Apress, 2014
4. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014
5. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley Publications, 2012

U23AIT62	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To present the mathematical, statistical and computational challenges of building neural networks
2. To study the concepts of deep learning
3. To introduce dimensionality reduction techniques
4. To enable the students to know deep learning techniques to support real-time applications
5. To examine the case studies of deep learning techniques.

UNIT I INTRODUCTON TO DEEP LEARNING 9

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DEEP NETWORKS 9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning.

UNIT III DIMENTIONALITY REDUCTION 9

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT IV OPTIMIZATION AND GENERALIZATION 9

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand basics of deep learning
- **CO 2:** Implement various deep learning models
- **CO 3:** Realign high dimensional data using reduction techniques
- **CO 4:** Analyze optimization and generalization in deep learning
- **CO 5:** Explore the deep learning applications.
- **CO 6:** Implementing real-time applications

TEXT BOOKS:

1. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016

REFERENCE BOOKS:

1. Cosma RohillaShalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

U23AIP61	IOT AND APPLICATIONS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

1. To design a simple Internet of Things (IoT) application using Arduino/Raspberry Pi, sensors and actuators
2. To deploy an IoT application using Arduino/Raspberry Pi and appropriate sensor and actuator
3. To build an IoT system using mobile app as a mini project

LIST OF EXPERIMENTS

1. Turn ON and OFF the LEDs.
2. Identify the objects using IR and PIR sensor.
3. Measure the moisture level of soil using soil moisture sensor.
4. Measure the distance between the ultrasonic sensor and the obstacle.
5. Identify the leakage of gas/smoke in the environment.
6. Measure the humidity and moisture value of the environment.
7. Control a LED using relay switch.

MINI PROJECT

Build an IoT system for the following suggested titles but not limited to:

8. Line follower robot
9. Smart weather monitoring system
10. Smart lighting system
11. Smart waste management system
12. Smart parking system

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Design a simple Internet of Things (IoT) application using Arduino/Raspberry Pi

CO 2: Design a simple Internet of Things (IoT) application using sensors and actuators

CO 3: Deploy an IoT application using Arduino/Raspberry Pi and appropriate

CO 4: Deploy an IoT application using sensor and actuator .

CO 5: Build an IoT system using mobile app as a mini project.

CO 6: Build an IoT system as a mini project

EQUIPMENT REQUIRED:

IoT Device

1. Microcontroller (Respberry Pi),Microcontroller (Arduino Uno/ESP8266/ESP32),Wi-Fi Module (ESP8266 if using Arduino Uno), Resistors (220Ω)

Sensors

IR Sensors (Infrared Proximity Sensor),PIR Sensor (Passive Infrared Sensor),Ultrasonic Sensor (HC-SR04),Soil Moisture Sensor, Ultrasonic Sensor (HC-SR04),DHT11/DHT22 (Humidity & Temperature Sensor),BMP180/BMP280 (Pressure Sensor, optional),Gas Sensor (MQ-2/MQ-135) IR Sensor, Rain Sensor

LED

LED (Red, Green, Blue), LED/Buzzer for indication

SEMESTER VI

U23CST72	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn the fundamentals of natural language processing.
2. To learn the word level analysis methods.
3. To explore the syntactic analysis concepts.
4. To understand the semantics and pragmatics.
5. 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, Dynamic Programming 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, WorldNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand text with basic Language features.

CO 2: Apply rule-based system to tackle morphology/syntax of a language

CO 3: Explain the concept of Context Free Grammar

CO 4: Explain Semantic analysis

CO 5: Build tools to process natural language and design innovative NLP applications.

CO 6: Evaluate lexical resources.

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

U23AIT72	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To understand the basic concepts of Robotic Process Automation.
2. To expose to the key RPA design and development strategies and methodologies.
3. To learn the fundamental RPA logic and structure.
4. To explore the Exception Handling, Debugging and Logging operations in RPA.
5. To learn to deploy and maintain the software bot.

UNIT I INTRODUCTION TO ROBOTIC AND AUTOMATION 9

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 9

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

UNIT-III APP INTEGRATION, RECORDING AND SCRAPIN 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Enunciate the key distinctions between RPA and existing automation techniques and platforms.
- **CO 2:** Use UiPath to design control flows and work flows for the target process
- **CO 3:** Implement recording, web scraping and process mining by automation
- **CO 4:** Use UIPath Studio to detect, and handle exceptions in automation processes
- **CO 5:** Implement automated bots and processes.
- **CO 6:** Use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

TEXT BOOKS:

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:

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

U23AIT73	AUGMENTED INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To impart the fundamental aspects and principles of AR/VR technologies
2. To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
3. To learn about the graphical processing units and their architectures
4. To gain knowledge about AR/VR application development.
5. To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION **9**

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 **9**

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 – Behavior Modeling – Model Management.

UNIT-III VR PROGRAMMING **9**

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT-IV APPLICATIONS **9**

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 **9**

Introduction to Augmented Reality-Computer vision for AR-Interaction - Modelling and Annotation Navigation-Wearable devices

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand the basic concepts of AR and VR
- **CO 2:** Understand the tools related to AR/VR
- **CO 3:** Understand the technologies related to AR/VR
- **CO 4:** Know the working principle of AR/VR related Sensor devices
- **CO 5:** Design of various models using modeling techniques
- **CO 6:** Develop AR/VR applications in different domains

TEXT BOOKS:

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

REFERENCE BOOKS:

1. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
2. William R. Sherman, Alan B. Craig: "Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003

U23AIT74	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To enable the students to create an awareness on Engineering Ethics and Human Values
2. To understand how to instill Moral and Social Values and Loyalty
3. To understand how to appreciate the rights of others.

UNIT I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT-II ENGINEERING ETHICS 9

Senses of "Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT-III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT-IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT-V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors Moral Leadership – Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society
- **CO 2:** Understanding the human values
- **CO 3:** Analyzing Engineering as Experimentation
- **CO 4:** Understanding about Intellectual Property Rights
- **CO 5:** Witnesses the global issues
- **CO 6:** Apply computer ethics and responsibilities of engineers

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004

REFERENCE BOOKS:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
6. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011

U23AIT75	ENTREPRENEUR AND STARTUP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE:

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

1. To develop and strengthen Entrepreneurial Spirit and Resourcefulness.
2. To convey the scope and opportunities of Human Resources for earning dignified means of living.
3. To impart the concept and process of Entrepreneurship, and its role in the Sustainable Development of individual and the Nation.
4. To empower with Entrepreneurial Quality, Competency and Motivation.
5. To provide the Skills and courage for Creation and Management of Entrepreneurial Venture efficiently and effectively.

UNIT 1 INTRODUCTION 9

Meaning and importance of Entrepreneurship, Evolution of the term entrepreneurship, Factors influencing entrepreneurship, characteristics of entrepreneurship, types of entrepreneurships, objectives of entrepreneurship development, Startups- Definition, Types

UNIT 2 ENTREPRENEURSHIP DEVELOPMENT SKILLS 9

Types of entrepreneurial skills - team work and leadership skill, analytical and problem-solving skills, critical thinking skills, branding, marketing and networking skills. Role of entrepreneurship development programmes (EDP)

UNIT 3 INSTITUTIONS SUPPORTING ENTREPRENEURS 9

Various Central and State Level Organizations Which Help the Entrepreneurs, Banks and non-banking financial organizations, Fund Collection for Entrepreneurship

UNIT 4 ENTREPRENEURIAL OPPORTUNITY AND ENTERPRISE PLANNING 9

Sensing entrepreneurial opportunities, selecting the right opportunity, Site Selection, Feasibility Analysis

UNIT 5 PREPARATION OF BUSINESS MODEL/PLAN 9

Business plan - concept, format, components of business plan. Significance of Business Plan. Making of a Business plan

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of this course, the Learners will be able to

CO 1: Understanding the dynamic role of entrepreneurship and Startups by Acquiring Entrepreneurial spirit and resourcefulness, quality, competency, and motivation

CO 2: Understanding the dynamic role of entrepreneurship resourcefulness, quality, competency, and motivation

CO 3: Illustrate 'Idea to Startup' entrepreneurial culture through Design Thinking, Technology based Business Innovations and Solution to Social Problems

CO 4: Select suitable Management practices like leadership and Ownership, resource institutes

CO 5: Overview of Support Agencies and Incubators.

CO 6: Assess the Challenges and Exit Strategies of Startups

TEXT BOOKS:

1. Kathleen R. Allen. 63. "Launching New Ventures: An Entrepreneurial Approach", 7th Edition.
2. Anjan Raichaudhuri, "Managing New Ventures Concepts and Cases", Prentice Hall International.2010

REFERENCE BOOKS:

1. S. R. Bhowmik & M. Bhowmik, "Entrepreneurship", New Age International.
2. Steven Fisher, Ja-nae' Duane, "The Startup Equation -A Visual Guidebook for Building Your Startup", Indian Edition, Mc Graw Hill Education India Pvt. Ltd.
3. Byrd Megginson, "Small Business Management an Entrepreneur's Guidebook", 7th edition, McGraw Hill.
4. "A Fayolle, "Entrepreneurship and new value creation", Cambridge, Cambridge University Press.

U23AIP71	NATURAL LANGUAGE PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

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

1. To learn NLTK and spaCy tools.
2. To learn the word collocations
3. To implement Part-of-Speech (PoS).
4. To implement chunking and chinking for any corpus.

LIST OF PROGRAMS:

1. Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.
2. (i)Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers.
   (ii)Check how many words are there in any corpus. Also check how many distinct words are there?
3. (i)Write a program to identify the word collocations.
   (ii) Write a program to print all words beginning with a given sequence of letters.
   (iii) Write a program to print all words longer than four characters.
4. (i) Write a program to identify the mathematical expression in a given sentence.
   (ii) Write a program to identify different components of an email address.
5. (i) Write a program to identify all antonyms and synonyms of a word.
   (ii) Write a program to find hyponymy, homonymy, polysemy for a given word.
6. (i) Write a program to find all the stop words in any given text.
   (ii) Write a function that finds the 50 most frequently occurring words of a text that are not stopwords.
7. (i) Write a program to implement Part-of-Speech (PoS) tagging for any corpus.
   (ii) Write a program to identify which word has the greatest number of distinct tags? What are they, and what do they represent?
   (iii) Write a program to list tags in order of decreasing frequency and what do the 20 most frequent tags represent?
   (iv) Write a program to identify which tags are nouns most commonly found after? What do these tags represent?
8. Write a program to implement TF-IDF for any corpus.
9. Write a program to implement chunking and chinking for any corpus.
10. Write the program to perform sentiment analysis using NLP

TOTAL: **60 PERIODS**

COURSE OUTCOMES:

At the end of the course, the students would be able to

CO 1: Use the NLTK and spaCy toolkit for NLP Programming.
CO 2: Analyze various corpora for developing programs.
CO 3: Develop programming of Part-of-Speech (PoS) tagging for any corpus
CO 4: Develop programming logic using NLTK functions.
CO 5: Build applications using various NLP techniques for a given corpus.
CO 6: Develop various pre-processing techniques for a given corpus.

EQUIPMENT REQUIRED

Required Components (Software & Libraries)

1. Programming Language: Python (version 3.7 or later recommended)
2. IDE/Text Editor: Jupyter Notebook, VS Code, PyCharm, or Google Colab
3. Python Libraries:
    - NLTK (pip install nltk)
    - spaCy (pip install spacy)
    - WordCloud (pip install wordcloud)
    - Scikit-learn (pip install scikit-learn)
    - TextBlob (pip install textblob)
    - Matplotlib (pip install matplotlib)
    - Pandas (pip install pandas)
    - NumPy (pip install numpy)
    - Regular Expressions (import re)
    - BeautifulSoup (for web scraping, if needed) (pip install beautifulsoup4)
4. Download NLP Corpora:
    - NLTK Corpora (nltk.download('all') or download specific corpora like stopwords, wordnet, etc.)
    - spaCy Language Model (python -m spacy download en_core_web_sm)

REFERENCE BOOK:

1. Toolkit Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python Analyzing Text with the Natural Language”.

U23AIP72	TRAINING & INTERNSHIP	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES

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

1. Get connected with reputed industry/ laboratory/academia / research institute
2. 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
3. Develop technical, soft, team skills to cater to the needs of the industry / academia / businesses / research / organizations in the core aspects of Automation, Digitalization

PROCESS

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

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Industry Practices, Processes, Techniques, technology, automation and other core aspects of software industry
CO 2: Analyze, Design solutions to complex business problems
CO 3: Build solutions for target platform,
CO 4: deploy solutions for target platform
CO 5: Preparation of Technical reports and presentation
CO 6: Preparation of Technical presentation

SEMESTER – VIII

		L	T	P	C
U23ITP81	**PROJECT WORK**	**0**	**0**	**20**	**10**

COURSE OBJECTIVES

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

1. For gaining domain knowledge, and technical skills to solve potential business / research problems.
2. Gather requirements and design suitable software solutions and evaluate alternatives
3. To work in small teams and understand the processes and practices in the 'industry.
4. Implement, Test and deploy solutions for target platforms
5. Preparing project reports and presentation

PROCESS

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.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Identify technically and economically feasible problems of social relevance.
CO 2: Plan and build the project team with assigned responsibilities
CO 3: Identify and survey the relevant literature for getting exposed to related solutions
CO 4: Analyze, design and develop adaptable and reusable solutions of minimal complexity by using modern tools
CO 5: Apply and test solutions to trace against the user requirements
CO 6: Classify and support the solutions for better manageability of the solutions and provide scope for improvability

VERTICALS-1
(DATA SCIENCE)

		L	T	P	C
U23CSV67	**KNOWLEDGE ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

1. To understand the basics of Knowledge Engineering.
2. To discuss methodologies and modeling for Agent Design and Development.
3. To design and develop ontologies.
4. To apply reasoning with ontologies and rules.
5. To understand learning and rule learning.

UNIT I INTRODUCTION 9

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

UNIT II METHODOLOGY AND MODELING 9

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 9

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

UNIT IV REASONIING WITH ONTOLOGIES AND RULES 9

Production System Architecture – Complex Ontology-based Concepts – Reduction and Synthesis rules and the Inference Engine – Evidence-based hypothesis analysis – Rule and OntologyMatching – Partially Learned Knowledge – Reasoning with Partially Learned Knowledge.

UNIT V LEARNING AND RULE LEARNING 9

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: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand the basics of Knowledge Engineering.

CO 2: Apply methodologies and modelling for Agent Design and Development.

CO 3: Design and develop ontologies.

CO 4: Apply reasoning with ontologies and rules.

CO 5: Understand learning and rule learning.

CO 6: Explain Hypothesis Learning.

TEXT BOOK:

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:

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.

U23AIV12	RECOMMENDER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the foundations of the recommender system.
2. To learn the significance of machine learning and data mining algorithms for Recommender systems
3. To learn about collaborative filtering
4. To make students design and implement a recommender system.
5. To learn collaborative filtering.

UNIT I INTRODUCTION 9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD)

UNIT II CONTENT-BASED RECOMMENDATION SYSTEMS 9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III COLLABORATIVE FILTERING 9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection

UNIT IV ATTACK-RESISTANT RECOMMENDER SYSTEMS 9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V EVALUATING RECOMMENDER SYSTEMS 9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Outline the basic concepts of recommender systems.
- **CO 2:** Explain machine-learning and data-mining algorithms in recommender systems data sets.
- **CO 3:** Illustrate the Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
- **CO 4:** Contrast and implement a simple recommender system.
- **CO 5:** Summarize the advanced topics of recommender systems.
- **CO 6:** Summarize the advanced topics of recommender systems applications

TEXT BOOKS:

1. Charu C. Aggarwal, "Recommender Systems: The Textbook", Springer, 2016.
2. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich, "Recommender Systems: An Introduction", Cambridge University Press (2011), 1st ed.

REFERENCE BOOKS:

1. Francesco Ricci, Lior Rokach, Bracha Shapira, "Recommender Systems Handbook", 1st ed, Springer (2011),
2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of massive datasets", 3rd edition, Cambridge University Press, 2020.

U23AIV13	SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
2. To provide the mathematical background for carrying out the optimization associated with neural network learning
3. To learn various evolutionary Algorithms.
4. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
5. 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 9

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 9

Supervised Learning Neural Networks – Perceptrons - Backpropagation - Multilayer Perceptrons – Unsupervised Learning Neural Networks – Kohonen Self-Organizing Networks

UNIT-III GENETIC ALGORITHMS 9

Chromosome Encoding Schemes -Population initialization and selection methods - Evaluation function - Genetic operators- Cross over – Mutation - Fitness Function – Maximizing function

UNIT-IV NEURO FUZZY MODELING 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand the fundamentals of fuzzy logic operators and inference mechanisms.
- **CO 2:** Understand neural network architecture for AI applications using classification.
- **CO 3:** Learn the functionality of Genetic Algorithms in Optimization problems.
- **CO 4:** Use hybrid techniques involving Neural networks and Fuzzy logic
- **CO 5:** Apply soft computing techniques in real world applications.
- **CO 6:** Understand neural network architecture for AI applications using clustering.

TEXT BOOKS:

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 with Case Studies and Applications from the Industry".

REFERENCE BOOKS:

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

U23CSV14 **TEXT AND SPEECH ANALYSIS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. Outline natural language processing basics
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop a speech recognition system
5. Develop a speech synthesizer

UNIT I NATURAL LANGUAGE BASICS 9

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

UNIT II TEXT CLASSIFICATION 9

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

UNIT III QUESTION ANSWERING AND DIALOGUE SYSTEMS 9

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

UNIT IV TEXT-TO-SPEECH SYNTHESIS 9

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

UNIT V AUTOMATIC SPEECH RECOGNITION 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Explain existing and emerging deep learning architectures for text and speech processing
- **CO 2:** Apply deep learning techniques for NLP tasks, language modelling and machine translation
- **CO 3:** Explain coreference and coherence for text processing
- **CO 4:** Build question-answering systems, chatbots and dialogue systems
- **CO 5:** Apply deep learning models for building speech recognition and text-to-speech systems
- **CO 6:** Explain HMM and DNN systems

TEXT BOOK:

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:

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.

U23CSV15	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Construct the Analytics Life Cycle.
2. Outline the process of acquiring Business Intelligence
3. Explain various types of analytics for Business Forecasting
4. Apply the supply chain management for Analytics.
5. Apply analytics for different functions of a business

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE 9

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions

UNIT III BUSINESS FORECASTING 9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modelling –Machine Learning for Predictive analytics.

UNIT IV HR & SUPPLY CHAIN ANALYTICS 9

Human Resources – Planning and Recruitment – Training and Development - Supply chain network Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain Applying HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V MARKETING & SALES ANALYTICS 9

Marketing Strategy, Marketing Mix, Customer Behavior – selling Process – Sales Planning – Analytics applications in Marketing and Sales - predictive analytics for customers' behavior in marketing and sales. Components of Power BI, Power BI architecture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Explain the real-world business problems and model with analytical solutions.
- **CO 2:** Identify the business processes for extracting Business Intelligence
- **CO 3:** Apply predictive analytics for business fore-casting
- **CO 4:** Apply analytics for supply chain and logistics management
- **CO 5:** Explain analytics for marketing and sales.
- **CO 6:** Extend predictive analytics for sales.

TEXT BOOKS:

1. R. Evans James, Business Analytics, 2nd Edition, Pearson, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2nd Edition, Wiley, 2016

REFERENCE BOOKS:

1. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
2. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
3. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education,2018.

U23CSV16 IMAGE AND VIDEO ANALYTICS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. Show the basics of image processing techniques for computer vision.
2. Apply the techniques used for image pre-processing.
3. Explain the various object detection techniques.
4. Classify the various Object recognition mechanisms.
5. Summarize the video analytics techniques.

UNIT I INTRODUCTION 9

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II IMAGE PRE-PROCESSING 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understand the basics of image processing techniques for computer vision and video analysis.
- **CO 2:** Explain the techniques used for image pre-processing.
- **CO 3:** Develop various object detection techniques.
- **CO 4:** Understand the various face recognition mechanisms.
- **CO 5:** Elaborate on deep learning-based video analytics.
- **CO 6:** Explain the techniques used for RestNet and Inception v3.

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

U23CBT51 THEORY OF COMPUTATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. Understand various Computing models like Finite State Machine, Pushdown Automata.
2. Understand various Computing models like Turing Machine.
3. Be aware of Decidability and Un-decidability of various problems.
4. Learn types of grammars.

UNIT I AUTOMATA FUNDAMENTALS 9

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions.

UNIT II REGULAR EXPRESSIONS AND LANGUAGES 9

Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular –Closure Properties of Regular Languages – Equivalence and Minimization of Automata

UNIT III CONTEXT FREE GRAMMAR AND LANGUAGES 9

CFG – Parse Trees – Ambiguity in Grammars and Languages – Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

UNIT IV PROPERTIES OF CONTEXT FREE LANGUAGES 9

Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.

UNIT V UNDECIDABILITY 9

Non-Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem, The Class P and NP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Construct automata theory using Finite Automata.
- **CO 2:** Write regular expressions for any pattern.
- **CO 3:** Design context free grammar and Pushdown Automata
- **CO 4:** Design Turing machine for computational functions
- **CO 5:** Differentiate between decidable and undecidable problems
- **CO 6:** Develop and implement the Class P and NP.

TEXT BOOKS:

1. Hopcroft, J.E. Motwani, R. and Ullman, J.D, "Introduction to Automata Theory, Languages andComputations", 2nd Edition, Pearson Education, 2013
2. Introduction to the Theory of Computation" by Michael Sipser

REFERENCE BOOKS:

1. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997
2. Martin, J., "Introduction to Languages and the Theory of Computation", 3rd Edition, TMH, 2003.
3. Lewis, H. and Papadimitriou, C.H "Elements of the Theory of Computation", 2nd Edition, PearsonEducation/PHI, 2003.
4. Greenlaw, "Fundamentals of Theory of Computation, Principles and Practice", Elsevier, 2008

VERTICALS-II
(FULL STACK DEVELOPMENT)

U23CSV22	APP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT **9**

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 **9**

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Development Frameworks, Java & Kotlin for Android, Swift & Objective-C for iOS.

UNIT III HYBRID APP DEVELOPMENT **9**

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 **9**

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.

UNIT V NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS **9**

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX, Reusability.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Develop Native applications with GUI Components.
- **CO 2:** Develop hybrid applications with basic event handling.
- **CO 3:** Implement cross-platform applications with location and data storage capabilities.
- **CO 4:** Implement cross platform applications with basic GUI and event handling.
- **CO 5:** Develop web applications with cloud database access.
- **CO 6:** Implement the non-functional characteristics of application frameworks.

TEXT BOOKS:

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.

REFERENCE BOOKS:

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.

U23CSV23	CLOUD SERVICES MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 9

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 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Explain cloud-design skills to build and automate business solutions using cloud technologies.
- **CO 2:** Extend Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.
- **CO 3:** Solve the real-world problems using Cloud services and technologies.
- **CO 4:** Discover Cloud service management operations.
- **CO 5:** Understand the pricing models for cloud services.
- **CO 6:** Evaluate the values of cloud services.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. "Economics of Cloud Computing", Praveen Ayyappa, LAP Lambert Academic Publishing.
2. "Mastering Cloud Computing Foundations and Applications Programming", Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi.

U23EET62	EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the Building Blocks of Embedded System.
2. To Educate in Various Embedded Development Strategies.
3. To Introduce Bus Communication in processors, Input/output interfacing.
4. To impart knowledge in Various processor scheduling algorithms.
5. To introduce Basics of Real time operating system and example tutorials to discuss on one real- time operating system tool

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols - RS232 standard – RS422 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – need for device drivers

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object-oriented Model.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS USING VLSI 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V EMBEDDED APPLICATION AND VLSI IMPLEMENTATION TRATEGY 9

Case Study of Washing Machine- Automotive Application- Smart card System Application. FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Operate various Embedded Development Strategies
CO 2: Suggest an embedded system for a given application.
CO 3: Understand and analyze Embedded systems.
CO 4: Understand basics of Real time operating system.
CO 5: Acquire knowledge on various processor scheduling algorithms.
CO 6: Design memory and array structures.

TEXT BOOKS:

1. Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. Peckol, "Embedded system Design", John Wiley & Sons,2010.
3. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013

REFERENCE BOOKS:

1. Shibu. K.V, "Introduction to Embedded Systems", Tata McGraw Hill,2009.
2. Elicia White," Making Embedded Systems", O' Reilly Series, SPD,2011.
3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
4. Han-Way Huang," Embedded system Design Using C8051", Cengage Learning,2009.
5. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007

U23CSV25	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I FOUNDATIONS OF SOFTWARE TESTING 9

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 9

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.

UNIT III TEST DESIGN AND EXECUTION 9

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.

UNIT IV ADVANCED TESTING CONCEPTS 9

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 9

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understand the basic concepts of software testing and the need for software testing.
- **CO 2:** Design Test planning and different activities involved in test planning.
- **CO 3:** Design effective test cases that can uncover critical defects in the application.
- **CO 4:** Extend out advanced types of testing.
- **CO 5:** Explain the software testing using Selenium and TestNG.
- **CO 6:** Understand Web driver events using automation tools.

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

U23CSV26	WEB APPLICATION SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I FUNDAMENTALS OF WEB APPLICATION SECURITY 9

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 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understanding the basic concepts of web application security and the need for it.
- **CO 2:** Explain the process for secure development and deployment of web applications.
- **CO 3:** Apply the skill to design and develop Secure Web Applications that use Secure APIs.
- **CO 4:** Explain the importance of carrying out vulnerability assessment and penetration testing.
- **CO 5:** Apply the skill to think like a hacker and to use hackers tool sets.
- **CO 6:** Construct the solutions for hacking problems using tools.

TEXT BOOKS:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, 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:

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, A press 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.

U23CSV17	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

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

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

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

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

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

UNIT IV 3D RECONSTRUCTION 9

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

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understand basic knowledge, theories and methods in image processing and computer vision.
- **CO 2:** Explain about advanced image processing techniques in OpenCV.
- **CO 3:** Apply 2D a feature-based based image alignment, segmentation and motion estimations
- **CO 4:** Apply 3D image reconstruction techniques
- **CO 5:** Design and develop innovative image processing and computer vision applications
- **CO 6:** Design and develop innovative computer vision applications

TEXT BOOKS:

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:

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

VERTICALS-III
(CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES)

		L	T	P	C
U23CST71	**CLOUD COMPUTING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

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

UNIT I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE 9

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 9

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 9

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 9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus – OpenStack.

UNIT V CLOUD SECURITY 9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyper jacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the design challenges in the cloud.

CO 2: Apply the concept of virtualization and its types.

CO 3: Experiment with virtualization of hardware resources and Docker

CO 4: Develop and deploy services on the cloud and set up a cloud environment

CO 5: Explain security challenges in the cloud environment.

CO 6: Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:

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
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

REFERENCE BOOKS:

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.

U23ITV31	DATA WAREHOUSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the fundamental concepts of data warehouse architecture, design, and implementation.
2. To equip students with knowledge of ETL processes (extraction, transformation, loading).
3. To teach data modeling techniques like star and snowflake schemas.
4. To differentiate schema types and explore data warehousing process architecture and parallelism.
5. To understand the roles of Data Warehousing Process and System Configuration Managers.

UNIT I INTRODUCTION TO DATA WAREHOUSE 9

Introduction - 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 9

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 9

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 9

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 – Data warehouse Tools.

UNIT V SYSTEM & PROCESS MANAGERS 9

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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand the fundamentals of data warehouse architecture for various Problems.
- **CO 2:** Explain the ETL and Online Analytical Processing Technologies and its operations.
- **CO 3:** Use the Categories of Metadata & Partitioning strategy technique.
- **CO 4:** Learn the differentiation of various schemas for given problem.
- **CO 5:** Frame roles of Data Warehousing Process Managers and System Configuration Managers.
- **CO 6:** Identify the skills and knowledge to effectively manage and optimize the various processes within a data warehouse.

TEXTBOOKS:

1. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Thirteenth Reprint 2010.
2. Ralph Kimball, "The Data Warehouse Toolkit: The Complete Guide to Dimensional Modeling", Third edition, 2013.

REFERENCE BOOKS:

1. Paul Raj Ponniah, "Data warehousing fundamentals for IT Professionals", 2012.
2. K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2014.

U23ITV65	OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand linear programming, graphical methods, and the simplex method.
2. To explore integer programming, branch and bound methods, and transportation problems.
3. To study project scheduling, CPM, PERT, and cost considerations in project management.
4. To learn classical optimization theory, unconstrained and constrained optimization problems.
5. To analyze queuing theory, system characteristics, and single/multiple service channel models.

UNIT I LINEAR MODELS 9

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP-Simplex Method-Two-Phase method.

UNIT II INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS 9

Integer programming: Branch and bound method- Transportation and Assignment problems – Traveling sales man problem.

UNIT III PROJECT SCHEDULING 9

Project network -Diagram representation – Floats - Critical path method (CPM) – PERT- Cost considerations in PERT and CPM.

UNIT IV CLASSICAL OPTIMIZATION THEORY 9

Unconstrained problems–necessary and sufficient conditions- Newton- Raphson method, Constrained problems–equality constraints–inequality constraints-Kuhn-Tucker conditions**.**

UNIT V QUEUING MODELS 9

Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the Formulate and solve linear programming problems (LPP).
CO 2: Evaluate Integer Programming Problems, Transportation and Assignment Problems.
CO 3: Use the solution to network problems using CPM and PERT techniques.
CO 4: Learn to optimize the functions object to the constraints.
CO 5: Identify and solve problems under Markovian queuing models.
CO 6: Explain Queuing system and multiple service channels.

TEXT BOOK:

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.

REFERENCE BOOKS:

1. ND Vohra, "Quantitative Techniques in Management", Tata Mc Graw Hill, 4thEdition, 2011.
2. J. K. Sharma, "Operations Research Theory and Applications", Macmillan, 5thEdition, 2012.
3. Hiller F.S, Liberman G.J, "Introduction to Operations Research", 10th Edition McGraw Hill, 2017.
4. Jit. S. Chandran, Mahendran P. Kawatra, Ki Ho Kim, "Essentials of Linear Programming", Vikas Publishing House Pvt. Ltd. New Delhi, 1994.
5. Ravindran A, Philip D.T., and Solberg J.J, "Operations Research", John Wiley, 2nd Edition, 2007.

U23ITV67	GAME THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the basics of game theory, rational choice, and its applications in various fields.
2. To study games with perfect information, including Nash equilibria and zero-sum games.
3. To explore games with imperfect information and Bayesian games, focusing on strategies and equilibria.
4. To understand non-cooperative game theory, analyzing optimality, equilibria, and strategy solutions.
5. To examine mechanism design, social choice, and protocols for strategic agents in decision-making systems.

UNIT I INTRODUCTION 9

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 9

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 9

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 9

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 9

Aggregating Preferences - Social Choice - Formal Model - Voting - Existence of social functions - Ranking systems - Protocols for Strategic Agents: Mechanism Design -Mechanism design with unrestricted references.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to,

CO 1: Discuss the notion of a strategic game and equilibria and identify the characteristics of main applications of these concepts.

CO 2: Understand the use of Nash Equilibrium for other problems.

CO 3: Identify key strategic aspects and based on these be able to connect them to appropriate game theoretical concepts given a real-world situation.

CO 4: Identify some applications that need aspects of Bayesian Games.

CO 5: Explain the typical Virtual Business scenario using Game theory.

CO 6: To grasp the essential of mechanism designs with unrestricted references.

TEXT BOOKS:

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.

REFERENCE BOOKS:

1. YoavShoham, Kevin Leyton-Brown, "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press 2008
2. Zhu Han, DusitNiyato, Walid Saad, TamerBasar and Are Hjorungnes, "Game Theory in Wireless and Communication Networks", Cambridge University Press, 2012. 7
3. Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific
4. William Spaniel, "Game Theory 101: The Complete Textbook", CreateSpace Independent Publishing, 2011.

U23AIV34 **JAVA PROGRAMMING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

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

1. To Learn about basics concepts of java.
2. To study about Inheritance and it types.
3. To implement interfacing and threading mechanism

UNIT I CLASS, METHODS AND STRINGS 9

History and Evolution of Java - An Overview of Java – Data types, variables, and Arrays- Operators – Control Statement – Introducing Class - Methods – String, String Buffer, StringBuilder

UNIT-II INHERITANCE, PACKAGE, INTERFACE AND EXCEPTION HANDLING 9

Inheritance, Packages and Interfaces - Exception Handling Fundamentals – Exception Types – Uncaught Exception – Using try and catch – Multiple catch Clauses – Nested try statement – throw – throws – finally – Built-in Exception- Creating our own Exception class – Chained Exception

UNIT III I/O AND THE COLLECTIONS FRAMEWORK 9

I/O Basics – Exploring java.io: Stream Class, Character Streams – Serialization - The Collections Framework – The ArrayList class – The HashSet class – Working with maps – The Vector class - Accessing a Collection via an Iterator.

UNIT IV GUI AND DATABASE CONNECTIVITY 9

Introducing Swing – Exploring Swing: JLabel, ImageIcon, JTextField, JButton, JList, JComboBox and JTable - Event Handling –- JDBC Programming concept – Executing Queries – Scrollable and Updatable Resultset.

UNIT V THREADS, GENERICS AND FUNCTIONAL PROGRAMMING 9

Threads - Interrupting Threads - Thread States - Thread Properties – Synchronization -Auto Boxing – Generics – Lambda Expressions - Functions as First-Class Objects -Pure Functions -Higher Order Functions.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Apply basic features of Java to write programs
- **CO 2:** Apply inheritance, package, interface and exceptions to write efficient programs.
- **CO 3:** Apply collection framework for writing efficient programs for real time applications.
- **CO 4:** Write GUI based data driven application using JDBC
- **CO 5:** Understanding the concepts of threads
- **CO 6:** Understanding about Functional programming.

TEXT BOOKS:

1. Herbert Schildt, "JavaTM : The Complete Reference", 9th edition, Oracle Press, 2014.
2. Anita Seth, B. L. Juneja, "JAVA: One Step Ahead", Oxford University Press, 2017.

REFERENCE BOOKS:

1. Cay S. Horstmann and Gary Cornell, "Core Java: Volume I – Fundamentals",9th edition, Prentice Hall,2013
2. K. Arnold, D. Holmes and J. Gosling, "The JAVA programming language",4th edition, Addison Wesley Professional, 2005.
3. Timothy Budd, "Understanding Object-oriented programming with Java", 3rd edition, Addison Wesley, 2000

U23CSV58	COGNITIVE SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To know the theoretical background of cognition.
2. To understand the link between cognition and computational intelligence.
3. To explore probabilistic programming language.
4. To study the computational inference models of cognition.
5. To study the computational learning models of cognition.

UNIT I PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE 9

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 9

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 9

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 9

Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.

UNIT V LEARNING MODELS OF COGNITION 9

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand the underlying theory behind cognition.
CO 2: Illustrate the cognition elements computationally.
CO 3: Evaluate mathematical functions through WebPPL.
CO 4: Develop applications using cognitive inference model.
CO 5: Design applications using cognitive learning model.
CO 6: Outline the learning models of continuous function.

TEXT BOOKS:

1. Vijay V Raghavan, Venkat N.Gudivada, VenuGovindaraju, C.R. Rao," Cognitive Computing: Theory and Applications: (Handbook of Statistics 35)", Elsevier publications, 2016.
2. Jose Luis Bermudez, "Cognitive Science - An Introduction to the Science of the Mind", Cambridge University Press 2020.

REFERENCE BOOKS:

1. Noah D. Goodman, Andreas Stuhl muller, "The Design and Implementation of Probabilistic Programming Languages", Electronic version of book, https://dippl.org/.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, "Probabilistic Models of Cognition", Second Edition, 2016, https://probmods.org/.

VERTICALS-IV
(CYBER SECURITY AND DATA PRIVACY)

U23CSV63	CYBER SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn cybercrime and cyberlaw.
2. To understand the cyber-attacks and tools for mitigating them.
3. To understand information gathering.
4. To learn how to detect a cyber-attack.
5. To learn how to prevent a cyber-attack.

UNIT I INTRODUCTION 9

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 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the basics of cyber security, cyber crime and cyber law

CO 2: Classify various types of attacks and learn the tools to launch the attacks

CO 3: Apply various tools to perform information gathering

CO 4: Apply intrusion techniques to detect intrusion

CO 5: Apply intrusion prevention techniques to prevent intrusion

CO 6: Develop and Evaluation of Intrusion Prevention Systems

TEXT BOOKS:

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)

REFERENCE BOOKS:

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013 (Unit 2)
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)

U23CSV34	STORAGE TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Characterize the functionalities of logical and physical components of storage
2. Describe various storage networking technologies
3. Identify different storage virtualization technologies
4. Discuss the different backup and recovery strategies
5. Understand common storage management activities and solutions

UNIT I STORAGE SYSTEMS 9

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 9

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 9

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 9

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 9

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:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students 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:** Illustrate 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
- **CO6:** Understand the functions of storage management process

TEXT BOOKS:

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

REFERENCE BOOK:

1. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, "Storage Networks Explained", Second Edition, Wiley, 2009

U23CSV46	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics of Block chain
2. To learn Different protocols and consensus algorithms in Block chain
3. To learn the Block chain implementation frameworks
4. To understand the Block chain Applications
5. To experiment the Hyper ledger Fabric, Ethereum networks

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Block chain- Public Ledgers, Block chain as Public Ledgers - Block in a Block chain- Transactions- The Chain and the Longest Chain – Permission ed Model of Block chain-Cryptographic -Hash Function- Properties of a hash function-Hash pointer and Merkle tree

UNIT II BITCOIN AND CRYPTOCURRENCY 9

Bitcoin scripting, Bit coin Scripts, Bit coin P2P Network, Transaction in Bit coin Network- Block A basic crypto currency-Creation of coins-Payments and double spending- FORTH–the precursor Mining- Block propagation and block relay

UNIT III BIT COINCONSENSUS 9

Bitcoin Consensus, Proof of Work (PoW) – Hash cash, PoW, Bitcoin PoW- Attacks on PoW- monopoly - problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner-Mining-Difficulty Mining Pool-Permission ed model and use cases.

UNIT IV HYPER LEDGER FABRIC &ETHEREUM 9

Architecture of Hyper ledger fabric v1.1- chain code- Ethereum-Ethereum network, EVM, Transaction fee- Mist Browser- Ether-Gas- Solidity.

UNIT V BLOCK CHAIN APPLICATIONS 9

Smart contracts, Truffle Design and issue- D Apps- NFT- Block chain Applications in Supply Chain-Management-Logistics- Smart Cities-Finance and Banking- Insurance, etc- Case Study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understand emerging abstract models for Block chain Technology
- **CO 2:** Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
- **CO 3:** Understand the function of Block chain as a method of securing distributed ledgers.
- **CO 4:** Apply hyper ledger Fabric and Ethereum plat form to implement the Block chain Application.
- **CO 5:** Discuss about knowledge on the options for network protection.
- **CO 6:** Utilize the Hyper ledger Fabric, Ethereum networks.

TEXT BOOKS:

1. Bashir and Imran, Mastering Block chain: Deeper insights into decentralization, cryptography, Bit coin, and popular Block chain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

REFERENCE BOOKS:

1. Daniel Drescher, "Block chain Basics", First Edition, Apress,2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Gold feder. "Bit coin and crypto currency technologies: a comprehensive introduction", Princeton University Press, 2016.

U23AIV44	R PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Automate data analysis
2. Working collaboratively and openly on code
3. Knowing how to generate dynamic documents

UNIT I INTRODUCTION **9**

Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

UNIT II VECTORS **9**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

UNIT III LISTS **9**

Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix- Like Operations

UNIT IV FACTORS AND TABLES **9**

Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables, extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

UNIT V OBJECT-ORIENTED PROGRAMMING **9**

S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Use and program in the programming language R
CO 2: Use R to solve statistical problems
CO 3: Implement and describe Monte Carlo the technology
CO 4: Minimize and maximize functions using R
CO 5: Understanding about functions of R.
CO 6: Understanding the object-oriented programming.

TEXT BOOKS:

1. "R Programming for Data Science", Roger D. Peng
2. "The Art of R Programming", Prashanth singh, Vivek Mourya, Cengage Learning India

REFERENCE BOOKS:

1. "R in Action", By Robert L. Kabacoff Latest Edition
2. "R for Data Science", By - Hadley Wickham and Garrett Gorlemund Latest Edition.
3. "The Art of R Programming" By - Norman Matloff.

U23AIV45 DATA AND INFORMATION SECURITY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics of Information Security
2. To know the legal, ethical and professional issues in Information Security
3. To equip the students' knowledge on digital signature, email security and web security

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: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to

CO 1: Understand the basics of data and information security
CO 2: Understand the legal, ethical and professional issues in information security
CO 3: Understand the various authentication schemes to simulate different applications.
CO 4: Understand various security practices and system security standards
CO 5: Understand the E-mail and IP Security for E-Commerce applications
CO 6: Understand the Web security protocols for E-Commerce applications

TEXT BOOKS:

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

REFERENCE BOOKS:

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

U23CSV44 **MODERN CRYPTOGRAPHY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To learn about Modern Cryptography
2. To focus on how crypto graphic algorithms and protocols work and how to use them.
3. To build a Pseudo random permutation.
4. To construct Basic cryptanalytic techniques
5. To provide instruction on how to use the concepts of block ciphers and message authentication codes.

UNIT I INTRODUCTION 9

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 FORMALNOTIONS OF ATTACKS 9

Attacks under Message In distinguish ability- Chosen Plain text 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 9

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, Pseudo- random Functions (PRF)

UNIT IV BUILDIN GAP SEUDO RANDOM PERMUTATION 9

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 9

Leftor Right Security (LOR). Formal Definition of Weak and Strong MACs, using a PR FasaMAC-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: 45 PERIODS

COURSE OUTCOMES:

Upon successful completion of this course, students will be able to

CO 1: Interpret the basic principles of cryptography and general crypt analysis.

CO 2: Determine the concepts of symmetric encryption and authentication.

CO 3: Identify the use of public key encryption, digital signatures, and key establishment.

CO 4: Explain the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.

CO 5: Extend the use of Message Authentication Codes.

CO 6: Analyze the perform of Shamir's Secret Sharing Scheme

TEXT BOOKS:

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:

1. Shaffi Gold wasser and Mihir Bellare, Lecture Notes on "Cryptography", Available at http://citeseerx.ist.psu.edu/.
2. Oded Gold reich, "Foundations of Cryptography", CRC Press (Low Priced Edition Available), Part 1 and Part 23

VERTICALS-V
(CREATIVE MEDIA)

U23CSV52	MULTIMEDIA AND ANIMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To grasp the fundamental knowledge of Multimedia elements and systems.
2. To get familiar with Multimedia file formats and standards.
3. To learn the process of Authoring multimedia presentations and animations.
4. To explore different popular applications of multimedia.
5. Understand the complexity of multimedia applications in the context of cloud, security, Big data streaming, social networking, CBIR etc,

UNIT I INTRODUCTION TO MULTIMEDIA 9

Definitions, Elements, Multimedia Hardware and Software, Distributed multimedia systems, challenges: security, sharing / distribution, storage, retrieval, processing, computing. Multimedia metadata, Multimedia databases, Hypermedia, Multimedia Learning.

UNIT II MULTIMEDIA FILE FORMATS AND STANDARDS 9

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 9

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 9

Principles of animation: staging, squash and stretch, timing, onion skinning, secondary action, 2D, 2 ½ D, and 3D animation, Animation techniques: Keyframe, 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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Develop the bigger picture of the context of Multimedia and its applications.
- **CO 2:** Make use of the different types of media elements of different formats on content pages.
- **CO 3:** Apply 2D and 3D creative and interactive presentations for different target multimedia applications.
- **CO 4:** Build different standard animation techniques for 2D, 21/2 D, 3D applications.
- **CO 5:** Understand the complexity of multimedia applications in the context of cloud, security, big data streaming, social networking, CBIR etc.,
- **CO 6:** Understand the applications of Multimedia.

TEXT BOOK:

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:

1. Mohsen Amini Salehi, Xiangbo Li, "Multimedia Cloud Computing Systems", Springer Nature, 1st Edition, 2021.
2. Emilio Rodriguez Martinez, Mireia Alegre 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.

U23AIV52 VIDEO CREATION AND EDITING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To introduce the broad perspective of linear and nonlinear editing concepts.
2. To understand the concept of Storytelling styles.
3. To be familiar with audio and video recording.
4. To apply different media tools.
5. To learn and understand the concepts of AVID XPRESS DV 4.

UNIT I FUNDAMENTALS 9

Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.

UNIT II STORYTELLING 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Compare the strengths and limitations of Nonlinear editing.
CO 2: Identify the infrastructure and significance of storytelling.
CO 3: Apply suitable methods for recording to CDs and VCDs
CO 4: Address the core issues of advanced editing and training techniques.
CO 5: Design and develop projects using final cut pro
CO 6: Design and develop projects using AVID XPRESS DV 4

TEXT BOOK:

1. Avid Xpress DV 4 User Guide, 2007

REFERENCE BOOKS:

1. Final Cut Pro 6 User Manual, 2004.
2. Keith Underdahl, "Digital Video for Dummies", Third Edition, Dummy Series, 2001.
3. Robert M. Goodman and Partick McGarth, "Editing Digital Video: The Complete Creative and Technical Guide", Digital Video and Audio, McGraw – Hill 2003

U23CSV54	DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. 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.
2. It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.
3. To learn the concept of E-mail Marketing.
4. To understand the concept of social media marketing.
5. To explore the digital trends.

UNIT I INTRODUCTION TO ONLINE MARKET 9

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT II SEARCH ENGINE OPTIMISATION 9

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 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- **CO 2:** Analyze how digital marketing can be utilized by organizations and how its effectiveness can be measured.
- **CO 3:** Explain the key elements of a digital marketing strategy.
- **CO 4:** Design how the effectiveness of a digital marketing campaign can be measured.
- **CO 5:** Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, social media and Blogs.
- **CO 6:** Develop the effectiveness of digital transformation.

TEXT BOOKS:

1. "Fundamentals of Digital Marketing", Puneet Singh Bhatia, Pearson Education. First edition (July 2017); ISBN-10: 933258737X; ISBN-13: 978-9332587373.
2. "Digital Marketing", Vandana Ahuja, Oxford University Press (April 2015). ISBN 10: 0199455449.

REFERENCE BOOKS:

1. Barker, Barker, Bormann and Neher(2017), "Social Media Marketing: A Strategic Approach", 2E South-Western ,Cengage Learning.
2. Pulizzi,J," Beginner's Guide to Digital Marketing", Mcgraw Hill Education.

U23CSV57 MULTIMEDIA DATA COMPRESSION AND STORAGE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basics of compression techniques.
2. To understand the categories of compression for text, image and video.
3. To explore the modalities of text, image and video compression algorithms.
4. To know about basics of consistency of data availability in storage devices.
5. To understand the concepts of data streaming services.

UNIT I BASICS OF DATA COMPRESSION 9

Introduction – Lossless and Lossy Compression – Basics of Huffmann coding- Arithmetic coding Dictionary techniques- Context based compression – Applications.

UNIT II IMAGE COMPRESSION 9

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 9

Introduction – Motion Compensation – Video Signal Representation – H.261 – MPEG-1- MPEG-2- H.263.

UNIT IV DATA PLACEMENT ON DISKS 9

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 9

Scheduling methods for disk requests – Feasibility conditions of concurrent streams– Scheduling methods for request streams.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the basics of text, Image and Video compression.
CO 2: Understand the various compression algorithms for multimedia content.
CO 3: Discuss the applications of various compression techniques.
CO 4: Illustrate the knowledge on multimedia storage on disks.
CO 5: Infer the scheduling methods for request streams.
CO 6: Identify the disk scheduling methods.

TEXT BOOKS:

1. Khalid Sayood, "Introduction to Data Compression, Morgan Kaufmann Series in Multimedia Information and Systems", 2018, 5th Edition.
2. Philip K.C.T, "Multimedia Information Storage and Retrieval: Techniques and Technologies", 2008.

REFERENCE BOOKS:

1. Lenald Best, "Best's Guide to Live Stream Video Broadcasting", BCB Live Teaching series, 2017.
2. Yun-Qing Shi, "Image and Video Compression For Multimedia Engineering Fundamentals Algorithms and Standards", Taylor& Francis, 2019.
3. Irina Bocharova, "Compression for Multimedia", Cambridge University Press; 1st edition, 2009.

U23ITV27	DEVOPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To learn DevOps, AWS, GCP, Azure, and Git.
2. Master Maven and Gradle for builds and dependencies.
3. Set up Jenkins for CI with Java, Git, and Maven.
4. To learn Ansible basics and playbooks.
5. Build DevOps pipelines with Azure.

UNIT I INTRODUCTION TO DEVOPS 9

DevOps Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and Github.

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE 9

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 Artifacts, Dependency management, Installation of Gradle, Understand build using Gradle.

UNIT III CONTINUOUS INTEGRATION USING JENKINS 9

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 9

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 9

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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO 1:** Understand different actions performed through version control tools like Git.
- **CO 2:** Perform continuous integration and continuous testing and continuous deployment using Jenkins by building and automating test cases using Maven & Gradle.
- **CO 3:** Ability to perform automated continuous deployment.
- **CO 4:** Ability to do configuration management using Ansible.
- **CO 5:** Understand to leverage cloud-based DevOps tools using Azure DevOps.
- **CO 6:** Use Github Accounts and Azure pipelines.

TEXT BOOKS:

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:

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. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", Second Edition, 2016.

U23AIV56	ETHICS AND AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION 9

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 9

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

UNIT III AI STANDARDS AND REGULATION 9

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 ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTIC 9

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

UNIT V AI AND ETHICS- CHALLENGES AND OPPORTUNITIES 9

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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Learn about morality and ethics in AI

CO 2: Acquire the knowledge of real time application ethics, issues and its challenges.

CO 3: Understand the ethical harms and ethical initiatives in AI

CO 4: Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems

CO 5: Understand the concepts of Robo ethics and Morality with professional responsibilities.

CO 6: Learn about the societal issues in AI with National and International Strategies on AI

TEXT BOOKS:

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:

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

VERTICALS-VI
(EMERGING TECHNOLOGIES)

		L	T	P	C
U23AIV61	**DISTRIBUTED COMPUTING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION 9

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 9

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time - Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III DISTRIBUTED MUTEX AND DEADLOCK 9

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – RicartAgrawala's 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 9

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure- Check pointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Check point-based Recovery – Coordinated Check pointing Algorithm - - Algorithm for Asynchronous Check pointing and Recovery

UNIT V CLOUD COMPUTING 9

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud - Cloud Services and Platforms: Compute Services – Storage Services – Application Services

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the foundations of distributed systems

CO 2: Solve synchronization and state consistency problems

CO 3: Use resource sharing techniques in distributed systems

CO 4: Apply working model of consensus and reliability of distributed systems

CO 5: Explain the fundamentals of cloud computing

CO 6: Explain about cloud services.

TEXT BOOKS:

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:

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

U23CSV66	3D PRINTING AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To discuss on basics of 3D printing
2. To explain the principles of 3D printing technique
3. To explain and illustrate inkjet technology
4. To explain and illustrate laser technology
5. To discuss the applications of 3D printing

UNIT I INTRODUCTION 9

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats.

UNIT II PRINCIPLE 9

Processes – Extrusion, Wire, Granular, Lamination, Photo polymerization; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations.

UNIT III INKJET TECHNOLOGY 9

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 – Continuous jet, MultiJet; Powder based fabrication Colourjet.

UNIT IV LASER TECHNOLOGY 9

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 9

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Outline and examine the basic concepts of 3D printing technology

CO 2: Outline 3D printing workflow

CO 3: Explain and categories the concepts and working principles of 3D printing using inkjet technique

CO 4: Explain and categories the working principles of 3D printing using laser technique

CO 5: Explain various method for designing and modeling for industrial applications

CO 6: Explain Future Trends in Manufacturing.

TEXT BOOKS:

1. Christopher Barnett, "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:

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", A Press, 2014.

U23CBT63	ETHICAL HACKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION 9

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

UNIT II FOOTPRINTING, RECONNAISSANCE AND SCANNING NETWORKS 9

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering- Footprinting Tools - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 9

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 OS

UNIT IV SYSTEM HACKING 9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network –Wardriving- Wireless Hacking - Tools of the Trade

UNIT V NETWORK PROTECTION SYSTEMS 9

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 – Honeypots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Evaluate knowledge on basics of computer-based vulnerabilities

CO 2: Analyze the different foot printing, reconnaissance and scanning methods

CO 3: Construct the enumeration and vulnerability analysis methods

CO 4: Discover knowledge on hacking options available in Web and wireless applications.

CO 5: Summarize knowledge on the options for network protection

CO 6: Illustrate tools to perform ethical hacking to expose the vulnerabilities

TEXT BOOKS:

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 BOOK:

1. "Black Hat Python: Python Programming for Hackers and Pen testers", Justin Seitz, 2014

U23ITV41	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To introduce digital forensics and its process.
2. To explore digital crime and evidence collection methods.
3. To understand digital forensic readiness for law enforcement and enterprises.
4. To study iOS device forensics, security, and tools.
5. To examine Android device forensics, tools, and security.

UNIT I INTRODUCTION TO DIGITAL FORENSICS 9

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 9

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 9

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 9

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 9

Basic– 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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand the knowledge on digital forensics.
CO 2: Know about digital crime and investigations.
CO 3: Be forensic ready.
CO 4: Identify digital evidence from iOS devices.
CO 5: Identify the digital from Android devices.
CO 6: Learn the Oxygen Forensics.

TEXT BOOKS:

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

REFERENCE BOOK:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed,Charles River Media, 2005, ISBN: 1-58450-389.

U23AIV65	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

1. To learn the foundations of Human Computer Interaction.
2. To become familiar with the design technologies for individuals and persons with disabilities.
3. To be aware of mobile HCI.
4. To learn the guidelines for user interface.

UNIT-I FOUNDATIONS OF HCI 9

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies

UNIT-II DESIGN & SOFTWARE PROCESS 9

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT-III MODELS AND THEORIES 9

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT-IV MOBILE HCI 9

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

UNIT-V WEB INTERFACE DESIGN 9

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Design effective dialog for HCI
CO 2: Design effective HCI for individuals and persons with disabilities.
CO 3: Assess the importance of user feedback.
CO 4: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
CO 5: Develop meaningful user interface.
CO 6: Explain the HCI implications for designing ecommerce/ e-learning Web sites.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale," Human Computer Interaction", 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, "Research Methods in Human Computer Interaction", Wiley, 2010

REFERENCE BOOKS:

1. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
2. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009. (UNIT-V)

U23AIV66	INFORMATION RETRIEVAL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To use an open-source search engine framework and explore its capabilities, represent documents in different ways and discuss its effect on similarity calculations and on search.
2. To modify Page Rank and HITS algorithms or Personalization, Semantic or any other aspect.
3. Design and implement an innovative feature in a search engine and explain the search components affected by the innovation

UNIT I INTRODUCTION 9

Introduction -History of IR- Components of IR - Issues –Open-source Search engine Frameworks, the impact of the web on IR - The role of artificial intelligence (AI) in IR – IR Versus Web Search - Components of a Search engine- Characterizing the web.

UNIT II INFORMATION RETRIEVAL 9

Boolean and vector-space retrieval models- Term weighting - TF-IDF weighting- cosine similarity – Preprocessing - Inverted indices - efficient processing with sparse vectors – Language Model based IR - Probabilistic IR –Latent Semantic Indexing - Relevance feedback and query expansion.

UNIT III WEB SEARCH ENGINE – INTRODUCTION AND CRAWLING 9

Web search overview, web structure, the user, paid placement, search engine optimization/ spam. Web size measurement - search engine optimization/spam – Web Search Architectures - crawling - meta- crawlers- Focused Crawling - web indexes –- Near-duplicate detection - Index Compression - XML retrieval

UNIT IV WEB SEARCH – LINK ANALYSIS AND SPECIALIZED SEARCH 9

Link Analysis –hubs and authorities - Page Rank and HITS algorithms -Searching and Ranking – Relevance Scoring and ranking for Web – Similarity - Hadoop & Map Reduce - Evaluation - Personalized search - Collaborative filtering and content-based recommendation of documents and products – handling “invisible” Web - Snippet generation, Summarization, Question Answering, Cross- Lingual Retrieval.

UNIT V DOCUMENT TEXT MINING 9

Information filtering; organization and relevance feedback – Text Mining -Text classification and clustering - Categorization algorithms: naive Bayes- decision trees and nearest neighbor - Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Use an open-source search engine framework and explore its capabilities
CO 2: Apply appropriate method of classification or clustering and web crawling.
CO 3: Design and implement innovative features in a search engine
CO 4: Understanding about link analysis and specialized search
CO 5: Understanding about document text mining
CO 6: Understanding about clustering algorithm

TEXT BOOKS:

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search (2nd Edition) (ACM Press Books) 2011

REFERENCE BOOKS:

1. Stefan Buettcher, Charles L. A. Clarke, Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010.
2. Ophir Frieder, "Information Retrieval: Algorithms and Heuristics", The Information Retrieval Series,2nd Edition, Springer; 2nd edition, 2004
3. Manu Konchady, "Building Search Applications", Lucene, LingPipe, and Gate Mustru publishing, First edition,2008

U23CSV64	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I QUANTUM COMPUTING BASIC CONCEPTS 9

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits – Super positions.

UNIT II QUANTUM GATES AND CIRCUITS 9

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction.

UNIT III QUANTUM ALGORITHMS 9

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 9

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantumnoiseless channel coding theorem - Classical information over noisy quantum channels.

UNIT V QUANTUM CRYPTOGRAPHY 9

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand the basics of quantum computing.

CO 2: Understand the background of Quantum Mechanics.

CO 3: Analyze the computation models.

CO 4: Build the circuits using quantum computation.Environments and frameworks.

CO 5: Understand the quantum operations such as noise and error–correction.

CO 6: Develop and Evaluation of Quantum Key Distribution Protocols.

TEXT BOOKS:

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:

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

OPEN ELECTIVES

U23AIO01	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the basic concepts of machine learning.
2. To understand and build supervised learning models.
3. To understand and build unsupervised learning models.
4. To evaluate the algorithms based on corresponding metrics identified

UNIT I INTRODUCTION TO MACHINE LEARNING 8

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off.

UNIT II SUPERVISED LEARNING 11

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes.

UNIT III ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING 9

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT IV NEURAL NETWORKS 9

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error back propagation, from shallow networks to deep networks – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS 8

Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, Assessing a single classification algorithm

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the basic concepts of machine learning.
CO 2: Construct supervised learning models.
CO 3: Construct unsupervised learning algorithms.
CO 4: Evaluate and compare different models.
CO 5: Acquire Knowledge in neural networks.
CO 6: Development of techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Second Edition, CRC Press, 2014.

REFERENCE BOOKS:

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2012, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing 3rd Edition, 2019.

U23CST62	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To Identify the various IoT elements appropriate to the applications
2. To Design a portable IoT using Arduino/Raspberry Pi incorporating cloud and analytics
3. To understand the Elements of IOT
4. To Learn about IoT Communication Models
5. To Implement IoT applications for real-time environment

UNIT I FUNDAMENTALS OF IOT 9

Introduction - Definition and Characteristics of IoT - Physical design - IoT Protocols - Logical design - IoT communication models, IoT Communication APIs - Enabling technologies - Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates - Domain specific IoTs - IoT Architectural view.

UNIT II ARDUINO PROGRAMMING 9

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 III ELEMENTS OF IOT 9

IoT and M2M- difference between IoT and M2M - Software Defined Networks - Network Function Virtualization - IoT systems management – Needs - NETCONF, YANG - IoT design methodology.

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 CHALLENGES IN IOT AND CASE STUDIES 9

Security Concerns and Challenges - Real time applications of IoT – Home automation – Automatic lighting – Home intrusion detection – Cities – Smart parking – Environment – Weather monitoring system – Agriculture – Smart irrigation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Describe the characteristics, physical and logical designs, domains and architecture.
CO 2: Explain about Arduino and its types
CO 3: Differentiate M2M and IoT, SDN and NFV design methodologies
CO 4: Compare the communication models in IOT
CO 5: Describe various real time applications of IOT
CO 6: Design IoT applications using Arduino/Raspberry Pi /open platform

TEXT BOOKS:

1. Arshdeep Bahga,VijayMadisetti, "Internet of Things-A hands-on approach", Universities Press, 2015
2. Olivier Hersent,DavidBoswarthick, Omar Elloumi,"The Internet of Things: Key applications and Protocols",Wiley Publications 2nd Edition,2013

REFERENCE BOOKS:

1. Raj Kamal, "Internet of Things–Architecture and Design Principles", McGraw Hill Education Pvt.Ltd.,2017
2. Internet of Things and Data Analytics, Hwaiyu Geng, P.E,Wiley Publications, 2017
3. Marco Schwartz,," Internet of Things with the Arduino Yun",Packt Publishing,2014
4. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", Wiley Publications, 2012.

U23AIT41 **ARTIFICIAL INTELLIGENCE**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. Learn the basic AI approaches
2. Develop problem solving agents
3. Perform logical reasoning
4. Perform probabilistic reasoning
5. Learn the Bayesian networks

UNIT I INTELLIGENT AGENTS **9**

Introduction to AI – Agents and Environments – concept of rationality – nature of environments – structure of agents. Problem solving agents – search algorithms – uninformed search strategies

UNIT II PROBLEM SOLVING **9**

Heuristic search strategies – heuristic functions. Local search and optimization problems – localsearch 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: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Explain intelligent agent frameworks
- **CO 2:** Apply problem solving techniques
- **CO 3:** Apply game playing and CSP techniques
- **CO 4:** Perform logical reasoning.
- **CO 5:** Perform probabilistic reasoning under uncertainty.
- **CO 6:** Apply the rules to obtain the Inference

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", Fourth Edition, Pearson Education, 2021.
2. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison- Wesley Educational Publishers Inc., 2011.

REFERENCE BOOKS:

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013.

U23AIO04 INTRODUCTION TO DATA SCIENCE

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

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

1. To understand fundamentals and the process of data science.
2. To comprehend different types and representation of data and analyze them.
3. To apply inferential techniques to extrapolate information from the available data.
4. To utilize the Python libraries for Data Wrangling.
5. To interpret data and present it using visualization libraries in Python

UNIT I INTRODUCTION 9

Data Science: Benefits and uses – facets of data – Data Science Process: Overview – Defining research goals – Retrieving data – Data preparation – Exploratory Data analysis – build the model – presenting findings and building applications

UNIT II DESCRIBING DATA 9

Types of Data – Types of Variables – Basic Statistical descriptions of Data – Describing Data with Tables and Graphs –Describing Data with Averages – Describing Variability – Normal Distributions and Standard (z) Scores

UNIT III PROBABILITY & STATISTICS 9

Probability Review, Joint & Conditional. Review on statistics- Populations and Samples – Sampling Distribution of the mean – Hypothesis testing – Z Test – One-Tailed and Two-Tailed Tests – Estimation-Test for one Sample – Analysis of Variance for one factor – Chi-Square Test

UNIT IV PYTHON LIBRARIES FOR DATA WRANGLIN 9

Basics of Numpy arrays – aggregations –computations on arrays –comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data.

UNIT V DATA VISUALIZATION 9

Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Understand data science fundamental and follow the correct process for applying data science.

CO 2: Represent and understand data in different formats and analyze it.

CO 3: Infer new information from the data using different analysis techniques.

CO 4: Gather, collect, and transform raw data into useful formats with Python libraries.

CO 5: Apply Python libraries to visualize and study data.

CO 6: Understanding the concepts of data visualization

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017

REFERENCE BOOKS:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
2. Avrim Blum, John Hopcroft, Ravindran Kannan, "Foundations of Data Science", Cambridge Press, 2020

U23AIO05	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To develop skills to both design and critique visualizations.
2. To introduce visual perception and core skills for visual analysis.
3. To understand visualization for time-series analysis.
4. To understand visualization for ranking analysis.
5. To understand visualization for deviation analysis.
6. To understand visualization for distribution analysis.
7. To understand visualization for correlation analysis

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs– multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – partto-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns. correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices

UNIT IV INFORMATION DASHBOARD DESIGN I 9

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

UNIT V INFORMATION GRAPHICS DESIGN II 9

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain principles of visual perception
CO 2: Apply core skills for visual analysis
CO 3: Apply visualization techniques for various data analysis tasks
CO 4: Design information dashboard.
CO 5: Understanding about visualization for distribution analysis
CO 6: Understanding about visualization for correlation analysis

TEXT BOOKS:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.

REFERENCE BOOKS:

1. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
2. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
3. Tamara Munzner, “Visualization Analysis and Design”, AK Peters Visualization Series, CRC Press, Nov. 2014

U23ITT43	WEB TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To comprehend and analyse the basic concepts of web programming and internet protocols.
2. To describe how the client-server model of Internet programming works.
3. To demonstrate the uses of scripting languages
4. To practice server-side programming features – PHP, JSP.
5. To be familiar with database applications

UNIT I WEBSITE BASICS 9

Internet Overview - Fundamental computer network concepts - Web Protocols - URL – Domain Name- Web Browsers and Web Servers- Working principle of a Website –Creating a Website - Client-side and server-side scripting.

UNIT II WEB DESIGNING 9

HTML – Form Elements - Input types and Media elements - CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.

UNIT III CLIENT-SIDE PROCESSING AND SCRIPTING 9

JavaScript Introduction – Variables and Data Types-Statements – Operators - Literals-Functions Objects-Arrays-Built-in Objects- Regular Expression, Exceptions, Event handling, Validation - JavaScript Debuggers.

UNIT IV TYPESCRIPT 9

Introduction of TypeScript, TypeScript Basics, Data types and variables, Destructuring and spread, Working with classes, working with interfaces, Generics, Modules and Name spaces, Ambients, Functions, Loops, Collections.

UNIT V SERVLETS AND DATABASE CONNECTIVITY 9

Introduction to AngularJS, MVC Architecture, understanding 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: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Create simple Website by understand the basics

CO2: Apply HTML and CSS effectively to create interactive and dynamic websites

CO3: Build dynamic web pages with validation using Java Script objects and apply different event handling mechanisms

CO4: Demonstrate simple web pages using Typescript

CO5: Illustrate Servlets in web applications

CO6: Create simple database applications.

TEXT BOOKS:

1. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" 5th Edition, O'Reilly publishers, 2018.
2. Paul Deitel, Harvey Deitel, Abbey Deitel, “Internet & World Wide Web - How to Program”, 6th edition, Pearson Education, 2020.

REFERENCE BOOKS:

1. Jeffrey C. Jackson, "Web Technologies-A Computer Science Perspective", Pearson Education, 2007.
2. James F. Kurose, “Computer Networking: A Top-Down Approach”, 6th Edition, Pearson Education, 2012
3. Steven Holzemer, “PHP – The Complete Reference”, 1st Edition, Mc-Graw Hill, 2017
4. Fritz Schneider, Thomas Powell, “JavaScript - The Complete Reference”, 3rd Edition, McGraw Hill Publishers, 2017

U23AIV61	DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

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

UNIT I INTRODUCTION 9

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 9

Logical Time: Physical Clock Synchronization: NTP – A Framework for a System of Logical Clocks – Scalar Time – Vector Time - Group Communication – Causal Order – Total Order; Global State and Snapshot Recording Algorithms: Introduction – System Model and Definitions – Snapshot Algorithms for FIFO Channels.

UNIT III DISTRIBUTED MUTEX AND DEADLOCK 9

Distributed Mutual exclusion Algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart Agrawala's 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 9

Consensus and Agreement Algorithms: Problem Definition – Overview of Results – Agreement in a Failure- Check pointing and Rollback Recovery: Introduction – Background and Definitions – Issues in Failure Recovery – Check point-based Recovery – Coordinated Check pointing Algorithm - - Algorithm for Asynchronous Check pointing and Recovery

UNIT V CLOUD COMPUTING 9

Definition of Cloud Computing – Characteristics of Cloud – Cloud Deployment Models – Cloud Service Models – Driving Factors and Challenges of Cloud - Cloud Services and Platforms: Compute Services – Storage Services – Application Services

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Explain the foundations of distributed systems

CO 2: Solve synchronization and state consistency problems

CO 3: Use resource sharing techniques in distributed systems

CO 4: Apply working model of consensus and reliability of distributed systems

CO 5: Explain the fundamentals of cloud computing

CO 6: Explain about cloud services.

TEXT BOOKS:

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:

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

U23AIO08	GRID COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. Understand how Grid computing helps in solving large scale scientific problems.
2. Gain knowledge on the concept of virtualization that is fundamental to cloud computing.
3. Learn how to program the grid and the cloud.
4. Understand the security issues in the grid and the cloud environment.

UNIT I INTRODUCTION 9

Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network- based systems – clusters of cooperative computers - Grid computing Infrastructures – cloud computing - service oriented architecture – Introduction to Grid Architecture and standards – Elements of Grid – Overview of Grid Architecture.

UNIT II GRID SERVICES 9

Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements – Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services

UNIT III VIRTUALIZATION 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software - Pros and Cons of cloud computing – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT IV PROGRAMMING MODEL 9

Open-source grid middleware packages – Globus Toolkit (GT4) Architecture, Configuration – Usage of Globus – Main components and Programming model - Introduction to Hadoop Framework - MapReduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.

UNIT V SECURITY 9

Trust models for Grid security environment – Authentication and Authorization methods – Grid security infrastructure – Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Apply grid computing techniques to solve large scale scientific problems
CO 2: Evaluate and apply the Open Grid Services Architecture
CO 3: Apply the concept of virtualization
CO 4: Deploy and utilize open-source grid middleware packages, including the Globus Toolkit (GT4) and Hadoop Framework.
CO 5: Design and implement effective trust models for grid security environments
CO 6: Proficient in securing cloud infrastructure

TEXT BOOK:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters,Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint ofElsevier, 2012.

REFERENCE BOOKS:

1. Jason Venner, "Pro Hadoop- Build Scalable, Distributed Applications in the Cloud", A Press, 2009
2. Tom White, "Hadoop the Definitive Guide", First Edition. O"Reilly, 2009.
3. Bart Jacob (Editor), "Introduction to Grid Computing", IBM Red Books, Vervante, 2005
4. Ian Foster, Carl Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", 2nd Edition, Morgan Kaufmann.
5. Frederic Magoules and Jie Pan, "Introduction to Grid Computing" CRC Press, 2009.
6. Daniel Minoli, "A Networking Approach to Grid Computing", John Wiley Publication, 2005.
7. Barry Wilkinson, "Grid Computing: Techniques and Applications", Chapman and Hall, CRC, Taylor and Francis Group, 2010

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U23AIO09	AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

1. To understand the concepts of Virtual Reality
2. To classify different input devices
3. To learn different models
4. To apply AR Software
5. To develop an application with VR experience

UNIT I INTRODUCTION TO VIRTUAL REALITY (VR) 9

Defining Virtual Reality, Key elements of virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace. Bird's-Eye View: Hardware, Software, Human Physiology and Perception.

UNIT II INPUT DEVICES 9

Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. Output Devices: Graphics displays, sound displays & haptic feedback.

UNIT III MODELING 9

Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.

UNIT IV AUGMENTED REALITY 9

Taxonomy, Technology and Features of Augmented Reality, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments

UNIT V INTERACTION & AUDIO 9

Interaction- Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio- The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO 1: Describe the concept of virtual reality and Communication Media.
CO 2: Understand current virtual reality hardware and software.
CO 3: Understand various modeling approaches.
CO 4: Illustrate the concepts of Human Factors and Applications of VR.
CO 5: Build a Virtual Reality Application.
CO 6: Understand Augmented Reality.

TEXT BOOKS:

1. "Virtual Reality Technology", Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc, 2017.
2. "Virtual Reality", Steven M. LaValle, Cambridge University Press, 2016

REFERENCE BOOKS:

1. Rajesh K. Maurya, "Computer Graphics with Virtual Reality System", 3rd Edition, Wiley Publication, 2018.
2. William R. Sherman and Alan B. Craig, "Understanding Virtual Reality Interface, Application, and Design", 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2019.
3. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", 2nd Edition, Wiley,2017.
4. K.S. Hale and K. M. Stanney, "Handbook on Virtual Environments", 2nd Edition, CRC Press, 2015.

U23CST72 **NATURAL LANGUAGE PROCESSING** **L T P C**

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COURSE OBJECTIVES

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

1. To learn the fundamentals of natural language processing.
2. To learn the word level analysis methods.
3. To explore the syntactic analysis concepts.
4. To understand the semantics and pragmatics.
5. 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, Dynamic Programming 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, WorldNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO 1: Understand text with basic Language features.

CO 2: Apply rule-based system to tackle morphology/syntax of a language

CO 3: Explain the concept of Context Free Grammar

CO 4: Explain Semantic analysis

CO 5: Build tools to process natural language and design innovative NLP applications.

CO 6: Evaluate lexical resources.

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

U23CSV46	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
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COURSE OBJECTIVES

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

1. To understand the basics of Block chain
2. To learn Different protocols and consensus algorithms in Block chain
3. To learn the Block chain implementation frameworks
4. To understand the Block chain Applications
5. To experiment the Hyper ledger Fabric, Ethereum networks

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Block chain- Public Ledgers, Block chain as Public Ledgers - Block in a Blockchain- Transactions- The Chain and the Longest Chain – Permission ed Model of Blockchain - Cryptographic -Hash Function- Properties of a hash function-Hash pointer and Merkle tree

UNIT II BITCOIN AND CRYPTOCURRENCY 9

Bitcoin scripting, Bitcoin Scripts, Bit coin P2P Network, Transaction in Bit coin Network- Block A basic crypto currency-Creation of coins-Payments and double spending- FORTH–the precursor Mining- Block propagation and block relay

UNIT III BIT COINCONSENSUS 9

Bitcoin Consensus, Proof of Work(PoW) – Hash cash, PoW, Bitcoin PoW- Attacks on PoW- monopoly - problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner-Mining- Difficulty Mining Pool-Permission ed model and use cases.

UNIT IV HYPER LEDGER FABRIC &ETHEREUM 9

Architecture of Hyper ledger fabric v1.1- chain code- Ethereum-Ethereum network, EVM, Transaction fee- Mist Browser- Ether-Gas- Solidity.

UNIT V BLOCK CHAIN APPLICATIONS 9

Smart contracts, Truffle Design and issue- D Apps- NFT- Block chain Applications in Supply Chain- Management-Logistics- Smart Cities-Finance and Banking- Insurance, etc,- Case Study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO 1:** Understand emerging abstract models for Block chain Technology
- **CO 2:** Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
- **CO 3:** Understand the function of Block chain as a method of securing distributed ledgers.
- **CO 4:** Apply hyper ledger Fabric and Ethereum plat form to implement the Block chain Application.
- **CO 5:** Discuss about knowledge on the options for network protection.
- **CO 6:** Utilize the Hyper ledger Fabric, Ethereum networks

TEXT BOOKS:

1. Bashir and Imran, Mastering Block chain: Deeper insights into decentralization, cryptography, Bit coin, and popular Block chain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

REFERENCE BOOKS:

1. Daniel Drescher, "Block chain Basics", First Edition, Apress,2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Gold feder. Bit coin and crypto currency technologies: A comprehensive introduction. Princeton University Press, 2016.