ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES (A)
(UGC Autonomous)
Approved by AICTE, Affiliated to Andhra University, Accredited by
N.B.A. & NAAC with 'A' Grade
(Estd : 2001)

2022-23

Academic Regulations (R19-CSE)

Curriculum & Syllabi (IV Year I&II Semesters)

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

VISION

Our vision is to emerge as a world class Computer Science and Engineering department through excellent teaching and strong research environment that responds swiftly to the challenges of changing computer science technology and addresses technological needs of the stakeholders.

MISSION

To enable our students to master the fundamental principles of computing and to develop in them the skills needed to solve practical problems using contemporary computer-based technologies and practices to cultivate a community of professionals who will serve the public as resources on state-of-the-art computing science and information technology.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-1	Employability	Work as Competent Computer Engineer either globally or locally by engaging in professional practice in a variety of roles with ability to serve as a team or individual.
PEO-2	Higher studies	Prepared to pursue masters or research programmes in computer science or other disciplines.
PEO-3	Entrepreneurship	Become successful Entrepreneurs who demonstrate strong technical and leadership skills to bring out innovative designs/products that also addresses social issues.
PEO-4	Lifelong learning and ethics	Adapt to rapidly changing technology in engineering domains through continuous learning and practice code of ethics.

PROGRAM SPECIFIC OUTCOMES (PSOs)

1	Programming and software Development skills: Ability to acquire programming efficiency to analyze, design and develop optimal solutions, apply standard practices in software project development to deliver quality software product.
2	Computer Science Specific Skills: Ability to formulate, simulate and use knowledge in various domains like data engineering, image processing and information and network security, artificial intelligence etc., and provide solutions to new ideas and innovations

PROGRAM OUTCOMES (POs)

Graduate Attribute1:	Engineering Knowledge
PO-1	Apply the knowledge of basic engineering sciences, humanities, core engineering and computing concept in modeling and designing computer based systems.
Graduate Attribute2:	Problem Analysis
PO-2	Identify, analyze the problems in different domains and define the requirements appropriate to the solution.
Graduate Attribute3:	Design/Development of Solution
PO-3	Design, implement & test a computer based system, component or process that meet functional constraints such as public health and safety, cultural, societal and environmental considerations.
Graduate Attribute4:	Conduct Investigations of Complex Problems
PO-4	Apply computing knowledge to conduct experiments and solve complex problems, to analyze and interpret the results obtained within specified timeframe and financial constraints consistently.
Graduate Attribute5:	Modern Tool Usage
PO-5	Apply or create modern techniques and tools to solve engineering problems that demonstrate cognition of limitations involved in design choices.
Graduate Attribute6:	The Engineer and Society
PO-6	Apply contextual reason and assess the local and global impact of professional engineering practices on individuals, organizations and society.
Graduate Attribute7:	Environment and Sustainability
PO-7	Assess the impact of engineering practices on societal and environmental sustainability.
Graduate Attribute8:	Ethics
PO-8	Apply professional ethical practices and transform into good responsible citizens with social concern.
Graduate Attribute9:	Individual and Team Work
PO-9	Acquire capacity to understand and solve problems pertaining to various fields of engineering and be able to function

	effectively as an individual and as a member or leader in a team.
Graduate Attribute10:	Communication
PO-10	Communicate effectively with range of audiences in both oral and written forms through technical papers, seminars, presentations, assignments, project reports etc.
Graduate Attribute11:	Project Management and Finance
PO-11	Apply the knowledge of engineering, management and financial principles to develop and critically assess projects and their outcomes in multidisciplinary areas.
Graduate Attribute12:	Life-long Learning
PO-12	Recognize the need and prepare oneself for lifelong self learning to be abreast with rapidly changing technology.

ANITS-CSE CURRICULUM – REGULATIONS –R19

I Year Course structure – CSE

Semester - I

Course Code	Title of the course	Category	Periods				Sessionals Marks	Semester end Exam	Total Marks	Credits
			L	T	P	Total				
CSE111	EngineeringMathematics – I	BS	3	0	0	3	40	60	100	3
CSE112	Communicative English	HS	3	0	0	3	40	60	100	3
CSE113	Basic Electronics Engineering	ES	3	0	0	3	40	60	100	3
CSE114	Digital Logic Design	ES	3	0	0	3	40	60	100	3
CSE115	PROBLEM SOLVING WITH C	ES	3	0	0	3	40	60	100	3
CSE116	English Language Lab	HS	0	0	3	3	50	50	100	1.5
CSE117	Problem solving with C – lab.	ES	0	0	3	3	50	50	100	1.5
CSE118	Environmental Science (Mandatory non-credit course)	BS	3	0	0	3	50	-	50	-
Total			**18**	**0**	**6**	**24**	**350**	**400**	**750**	**18**

I Year Course structure – CSE

Semester - II

Course Code	Title of the course	Category	Periods				Sessionals Marks	Semester end Exam	Total Marks	Credits
			L	T	P	Total				
CSE121	Engineering Mathematics – II	BS	3	0	0	3	40	60	100	3
CSE122	Engineering Physics	BS	3	0	0	3	40	60	100	3
CSE123	Engineering Chemistry	BS	3	0	0	3	40	60	100	3
CSE124	ELEMENTS OF ELECTRICAL ENGINEERING	ES	3	0	0	3	40	60	100	3
CSE125	Engineering Drawing	ES	2	0	3	5	40	60	100	3.5
CSE126	Engineering Physics Lab.	BS	0	0	3	3	50	50	100	1.5
CSE127	Engineering Chemistry Lab.	BS	0	0	3	3	50	50	100	1.5
CSE128	Engineering Workshop	ES	0	0	3	3	50	50	100	1.5
CSE129	Human Values and Professional Ethics(Mandatory non-credit course)	HS	3	0	0	3	50	0	50	-
Total			**17**	**0**	**12**	**29**	**400**	**450**	**850**	**20**

II Year Course structure – CSE

Semester - I

CODE	SUBJECT NAME	Category	Periods				Sessionals Marks	Semester end Exam	Total Marks	Credits
			L	T	P	Total				
CSE 211	DATA STRUCTURES&ALGORITHMS	PC	2	1	0	3	40	60	100	3
CSE 212	COMPUTER ORGANIZATION	PC	3	0	0	3	40	60	100	3
CSE 213	JAVA PROGRAMMING	PC	3	0	0	3	40	60	100	3
CSE 214	DATA COMMUNICATION	PC	3	0	0	3	40	60	100	3
CSE 215	DISCRETE MATHEMATICAL STRUCTURES	BS	3	0	0	3	40	60	100	3
CSE 216	DESIGN THINKING & PRODUCT INNOVATION	ES	2	0	2	4	40	60	100	3
CSE 217	***JAVA PROGRAMMING LAB***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
CSE 218	***DATA STRUCTURES LAB USING C***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
Total			**16**	**1**	**8**	**25**	**340**	**460**	**800**	**21**

II Year Course structure – CSE

Semester - II

CODE	SUBJECT NAME	Category	Periods				Sessionals Marks	Semester end Exam	Total Marks	Credits
			L	T	P	Total				
CSE 221	PROBABILITY , STATISTICS AND QUEUING THEORY	BS	3	0	0	3	40	60	100	3
CSE 222	MICROPROCESSOR & INTERFACING	PC	2	1	0	3	40	60	100	3
CSE 223	OPERATING SYSTEMS	PC	3	0	0	3	40	60	100	3
CSE 224	COMPUTER NETWORKS	PC	3	0	0	3	40	60	100	3
CSE 225	COMPUTER GRAPHICS	PC	2	1	0	3	40	60	100	3
CSE 226	FORMAL LANGUAGES AND AUTOMETA THEORY	PC	2	1	0	3	40	60	100	3
CSE 227	***MICRO PROCESSOR INTERFACING LAB***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
CSE 228	***OPERATING SYSTEM LAB***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
Total			**15**	**3**	**6**	**24**	**340**	**460**	**800**	**21**

III Year Course structure – CSE

Semester - I

CODE	SUBJECT NAME	Category	Periods				Sessionals Marks	Semester end Exam	Total Marks	Credits
			L	T	P	Total				
CSE 311	OPEN ELECTIVE-I *(Essentials of Python as EC)	OE	3	0	0	3	40	60	100	3
CSE 312	PROFESSIONAL ELECTIVE -I	PE	3	0	0	3	40	60	100	3
CSE 313	COMPETITIVE PROGRAMMING	PC	2	1	0	3	40	60	100	3
CSE 314	COMPILER DESIGN	PC	2	1	0	3	40	60	100	3
CSE 315	DATA BASE MANAGEMENT SYSTEMS	PC	3	0	0	3	40	60	100	3
CSE 316	DESIGN & ANALYSIS OF ALGORITHMS	***PC***	2	1	0	3	40	60	100	3
CSE 317	***QA-I &SOFT SKILLS***	***HS***	0	0	3	3	***100***	***0***	100	1.5
CSE 318	***COMPETITIVE PROGRAMMING LAB***	***PC***	0	0	***3***	3	***50***	***50***	100	1.5
CSE 319	***DATA BASE MANAGEMENT SYSTEMS LAB***	***PC***	0	0	***3***	3	***50***	***50***	100	1.5
CSE 320	Constitution of India & - Intellectual Property Rights	HS	2	0	0	2	50	0	50	-
Total			**17**	**3**	**9**	**29**	**490**	**460**	**950**	**22.5**

III Year Course structure – CSE

Semester - II

CODE	SUBJECT NAME	Category	Periods				Sessionals Marks	Semester end Exam marks	Total Marks	Credits
			L	T	P	Total				
CSE 321	OPEN ELECTIVE -II*	OE	3	0	0	3	40	60	100	3
CSE 322	PROFESSIONAL ELECTIVE -II	PE	3	0	0	3	40	60	100	3
CSE 323	PROFESSIONAL ELECTIVE -III	PE	3	0	0	3	40	60	100	3
CSE 324	OBJECT ORIENTED SOFTWARE ENGINEERING	PC	3	0	0	3	40	60	100	3
CSE 325	WEB TECHNOLOGIES	PC	2	1	0	3	40	60	100	3
CSE 326	CRYPTOGRAPHY AND NETWORK SECURITY	PC	3	0	0	3	40	60	100	3
CSE 327	**QA-II&VERBAL ABILITY**	HS	0	0	3	3	***100***	***0***	100	1.5
CSE 328	***OBJECT ORIENTED SOFTWARE ENGINEERING LAB***	***PC***	0	0	***3***	3	***50***	***50***	100	1.5
CSE 329	***WEB TECHNOLOGIES LAB***	***PC***	0	0	***3***	3	***50***	***50***	100	1.5
Total			**17**	**1**	**9**	**27**	**440**	**460**	**900**	**22.5**

IV Year Course structure – CSE										
Semester - I										
CODE	**SUBJECT NAME**	**Category**	**Periods**				**Sessionals Marks**	**Semester end Exam**	**Total Marks**	**Credits**
			L	**T**	**P**	**Total**				
CSE 411	OPEN ELECTIVE -III*(**Block Chain** as EC)	OE	3	0	0	3	40	60	100	3
CSE 412	PROFESSIONAL ELECTIVE -IV	PE	3	0	0	3	40	60	100	3
CSE 413	PROFESSIONAL ELECTIVE -V	PE	3	0	0	3	40	60	100	3
CSE 414	PRINCIPLES OF MANAGEMENT AND FINANCIAL ACCOUNTING	HS	3	0	0	3	40	60	100	3
CSE 415	DATA ANALYTICS	PC	2	1	0	3	40	60	100	3
CSE 416	***CRYPTOGRAPHY & NETWORK SECURITY LAB***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
CSE 417	***DATA ANALYTICS LAB***	***PC***	0	0	***3***	3	***50***	***50***	***100***	1.5
CSE 418	***PROJECT -I***	***PR***	0	0	***3***	3	***100***	***0***	***100***	2
CSE 419	***SUMMER INTERNSHIP-INDUSTRY***	***PR***	0	0	***0***	0	***100***	***0***	***100***	1
Total			**14**	**1**	**9**	**24**	**500**	**400**	**900**	**21**

IV Year Course structure – CSE										
Semester - II										
CODE	**SUBJECT NAME**	**Category**	**Periods**				**Sessionals Marks**	**Semester end Exam**	**Total Marks**	**Credits**
			L	**T**	**P**	**Total**				
CSE 421	OPEN ELECTIVE -IV*	OE	3	0	0	3	40	60	100	3
CSE 422	PROFESSIONAL ELECTIVE -VI/MOOC	PE	3	0	0	3	40	60	100	3
CSE 423	***PROJECT -II***	***PR***	0	0	9	9	***100***	***100***	***200***	8
Total			**6**	**0**	**9**	**15**	**180**	**220**	**400**	**14**

Total Credits **160**

*Open Elective can be Inter Department Disciplinary Course,Emerging Courses or MOOC. Final decision will be taken by the department.

List of Professional Electives	
PE1 3rd Yr-Sem -1	•CSE 312(A)Embedded Systems •CSE312(B)Advanced Data Structures •CSE312(C)Digital ImageProcessing .CSE 312(D)Artificial Intelligence
PE2 3rd Yr-Sem -2	•CSE322(A)Human Computer Interaction •CSE 322(B) Mobile Computing .CSE322(C)No SQL Data Bases .CSE322(D)Data warehousing and Data mining
PE3 3rd Yr-Sem -2	• CSE323(A)Distributed Operating Systems • CSE323(B)Smart Systems Design & Programming • CSE323(C)Machine Learning • CSE323(D)Computer vision
PE4 4th Yr-Sem -1	.CSE412(A)Natural Language Processing • CSE412(B)Bioinformatics .CSE 412(C)High Performance Computing • CSE415(D)Neural Networks & Deep Learning
PE5 4th Yr-Sem -1	.CSE413(A)IOT • CSE413(B)AugmentedReality • CSE413(C)Semantic Web • CSE413(D)Multimedia & Animation
PE6 4th Yr-Sem -2	.CSE422(A) Informaional Retrieval System • CSE422(B) Cyber Security • CSE422(C)Social Network Analysis • CSE422(D) Cloud Computing

OPEN ELECTIVES	
OE 1 3rd Yr-Sem -1	CSE 311 Essentials of Python (as emerging subject) Python Programming
OE2 3rd Yr-Sem -2	FILE SYSTEMS & DATA BASES COMPUTER OPERATING SYSTEMS FUNDAMENTALS OF COMPUTER NETWORKS
OE3 4th Yr-Sem -1	Foundations of Linux, Introduction to Data Analytics, Cyber forensics
OE4 4th Yr-Sem -2	Cloud Technologies, Introduction to Soft Computing, Sensor Technologies&Drones

BLOCKCHAIN	
CSE 411(OE as Emerging Subject)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks: 40
End Exam : 3 Hours	End Exam Marks: 60

Prerequisites:

- Knowledge of Data structures.
- Students must have knowledge of some programming languages (such as C, C++, and Java).

Course Objectives:

- Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
- Design, build, and deploy smart contracts and distributed applications.
- Integrate ideas from blockchain technology into their own projects.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Explain the basic concepts and technology used for blockchain
2.	Describe the primitives of the distributed computing and cryptography related to blockchain.
3.	Illustrate the concepts of Bitcoin and their usage
4.	Analyze the working of Ethereum and Smart Contracts
5.	Design and build Smart Contracts.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	3	2	-	-	-	-	-	-	1	-	-	-	-
2	2	3	3	-	-	-	-	-	-	1	-	-	2	1
3	2	3	2	-	-	-	-	-	-	2	-	-	2	-
4	3	3	2	2	-	-	-	-	-	2	-	2	2	2
5	3	3	3	2	-	-	-	-	-	2	-	2	2	2

SYLLABUS

UNIT-I: 8 Periods

Introduction of Blockchain: Back-story of Blockchain, What is Block chain, Centralized Vs Decentralized Systems, Layers of Blockchain, Why Blockchain is Important? Blockchain uses and use cases, Public Vs Private Blockchains.

Learning Outcomes: At the end of this unit, Students are able to

1. Explain the need of Blockchain
2. Describe the benefits of Blockchain

UNIT II: 14 Periods

How Blockchain Works: Laying the Blockchain foundation, Cryptography, Symmetric Key Cryptography, MAC and HMAC, Asymmetric Key Cryptography, Game Theory: Nash Equilibrium, Prisoner's Dilemma, Byzantine Generals Problem, Blockchain data structure, Merkle Trees, Properties of Blockchain Solutions, Distributed Consensus Mechanisms, Blockchain Applications, and Scaling Blockchain.

Learning Outcomes: At the end of this unit, Students are able to

1. Describe the Blockchain working.
2. Explain the different Cryptographic Concepts used in Blockchain

UNIT-III: 12 Periods

How Bitcoin Works: The History of Money, Dawn of Bitcoin, What Is Bitcoin?, Working with Bitcoins, The Bitcoin Blockchain, Block Structure, The Genesis Block, The Bitcoin Network, Network Discovery for a New Node, Bitcoin Transactions, Consensus and Block Mining, Block Propagation, Bitcoin Scripts, Full Nodes Vs SPVs, Bitcoin Wallets.

Learning Outcomes: At the end of this unit, Students are able to

1. Illustrate the concept of Bitcoin
2. Explain different primitive concepts related to Bitcoin

UNIT-IV: 14 Periods

How Ethereum Works: From Bitcoin to Ethereum: Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, **Enter the Ethereum Blockchain**: Ethereum Blockchain, Ethereum Accounts, Trie Usage, Merkle Patricia Tree, RLP Encoding, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost.
Ethereum Smart Contracts, Ethereum Virtual Machine and Code Execution, Ethereum Ecosystem.

Learning Outcomes: At the end of this unit, Students are able to

1. Describe How Ethereum works
2. Analyze how Smart Contracts are used in Ethereum

UNIT-V: 12 Periods

Blockchain Application Development:

Interacting with the Bitcoin Blockchain, Setup and Initialize the bitcoinjs Library in a node.js Application, Interacting Programmatically with Ethereum—Sending Transactions, Interacting Programmatically with Ethereum—Creating a Smart Contract, Interacting Programmatically with Ethereum—Executing Smart Contract Functions.

Learning Outcomes: At the end of this unit, Students are able to

1. Design programs to interact with Blockchain
2. Build Smart Contracts

Text Books:

1. Bikramaditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda, "Beginning Blockchain:A Beginner's Guide to Building Blockchain Solutions" 2018, Apress
2. Antonopoulos and G. Wood, "Mastering Ethereum" 1st Edition,2018, O'Reilly Publications

Reference Books:

1. Antonopoulos, "Mastering Bitcoin" 1st Edition, 2014, O'Reilly Publications

Web Resources:

1. **https://solidity-by-example.org/**
2. https://www.coursera.org/learn/blockchain-basics
3. https://cs251.stanford.edu/syllabus.html

Prepared By
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NATURAL LANGUAGE PROCESSING	
CSE 412(A)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Formal-language/automata theory, Artificial Intelligence, Machine learning

Course Objectives:

- Learn about the lexical, syntactic, and semantic analysis of natural language processing.
- Explore N-gram Language Models.for language processing.
- Understand the statistical models for Natural language processing.
- Study the machine translation principles.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Demonstrate Parsing Techniques for Natural Language, Text preprocessing and Tokenization Techniques.
2	Evaluate Language Models through probability distribution and word sequence.
3	Apply word embedding's to find similarity and semantics of the language.
4	Apply Sequence labeling for POS Tagging and Select the appropriate method to evaluate the named entity recognition.
5	Examine Machine Translations and Encoder-Decoder Models for language processing.

Mapping of course outcomes with program outcomes:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	-	-	-	-	-	-	-	1	-	2	-	1
2	3	2	2	2	2	-	-	-	-	1	-	1	2	2
3	2	2	2	2	2	-	-	-	1	1	-	1	2	2
4	3	2	2	2	2	1	-	-	1	1	-	1	2	2
5	2	2	1	2	2	1	-	-	1	1	-	1	2	2

SYLLABUS

UNIT-I: Classical Approaches to NLP **12 periods**

Context, The Classical Toolkit-Text preprocessing, Lexical Analysis, Syntactic Parsing, Semantic Analysis, Natural Language Generation.

Text preprocessing-Introduction, Challenges of Text Preprocessing-Character-Set Dependency, Language Dependency, Corpus Dependency, Application Dependency.

Tokenization-Tokenization in space-Delimited Languages, Tokenization on unsegmented languages, Sentence Segmentation-Sentence Boundary Punctuation.

Learning Outcomes: At the end of this unit, the students will be able to

1. Interpret the steps of Natural Language Processing.
2. Summarize the challenges of Text preprocessing- Tokenization, Sentence Segmentation.

UNIT-II: N-gram Language Models **12 periods**

N-Grams, Evaluating Language Models, Generalization and Zeros, Smoothing Kneser-Ney Smoothing, Huge Language Models and Stupid Back off, Advanced: Perplexity's Relation to Entropy.

Learning Outcomes: At the end of this unit, the students will be able to

1. Find the probability distribution over word sequences.
2. Explore N- Gram Evaluating Language Models.

UNIT-III: Vector Semantics and Embedding's **12 periods**

Lexical Semantics, Vector Semantics, Words and Vectors, Cosine for measuring similarity,

TF-IDF: Weighing terms in the vector, Pointwise Mutual Information (PMI), Applications of the tf-idf or PPMI vector models, Word2vec, Visualizing Embeddings, Semantic properties of embeddings, Bias and Embeddings, Evaluating Vector Models.

Learning Outcomes: At the end of this unit, the students will be able to

1. Apply similarity measures for language processing
2. Illustrate word embedding techniques for semantic text processing

UNIT-IV: Sequence Labeling for Parts of Speech and Named Entities **12 periods**

English Word Classes, Part-of-Speech Tagging, Named Entities and Named Entity Tagging, HMM Part-of-Speech Tagging, Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition.

Learning Outcomes: At the end of this unit, the students will be able to

1. Construct Sequence labeling for POS Tagging
2. Evaluate Named Entity Recognition for text classification.

UNIT-V: Machine Translation and Encoder-Decoder Models **12 periods**

Language Divergences and Typology, The Encoder-Decoder Model, Encoder-Decoder with RNNs, Attention Beam Search, Encoder-Decoder with Transformers, Some practical details on building MT systems, MT Evaluation, Bias, and Ethical Issues.

Learning Outcomes: At the end of this unit, the students will be able to

1. Identify the benefits of Encoder- Decoder.
2. Evaluate Machine Translation Models.

Textbooks:

1. Nitin Indurkhya and Fred J.Damerau,"Handbook of Natural Language Processing", Second Edition, CRC Press,2010.(UNIT-I)
2. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2020.(UNIT-II, UNIT-III, UNIT-IV, UNIT-V)

Reference Books:

1. Manning, Christopher D., and Hinrich Schütze, "*Foundations of Statistical Natural Language Processing*." Cambridge, MA: MIT Press, 1999. ISBN: 0262133601.

Web Resources:

1. https://nptel.ac.in/courses/106105158
2. https://www.mit.edu/~jda/teaching/6.864/sp21/

Prepared By

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Dr. M. Rama Krishna Murthy, Professor, Dept of CSE
Mr. P. Krishnanjaneyulu, Assistant Professor, Dept of CSE

BIO-INFORMATICS	
CSE 412(B)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Python programming
- Basic knowledge on clustering techniques

Course Objectives:

- Understand the importance of Bio informatics.
- Apply data analytics using various big data tools on real world data sets.

Course Outcomes:

By the end of the course, the student will be able to:

CO1	Develop Programs to analyze DNA, mRNA sequence
CO2	Analyze and annotate BIOSEQs collected from NCBI.
CO3	Illustrate Genbank and FASTA files and parse files using Biopython.
CO4	Develop algorithms to analyze single and multiple Sequence Alignments
CO5	Apply K-means Clustering techniques to the Measurements extracted from biological systems.

CO-PO Mapping:

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
2	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
3	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
4	**2**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**
5	**1**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**

SYLLABUS

UNIT-I **12periods**

Transcribing DNA into mRNA: Reading and Writing Files, Getting Started, Defining the Program's Parameters , Defining an Optional Parameter, Defining One or More Required Positional Parameters , Outlining the Program Using Pseudocode , Iterating the Input Files, Creating the Output Filenames ,Opening the Output Files ,Writing the Output Sequences ,Printing the Status Report ,Using the Test Suite. **(Text Book 3)**

Learning Outcomes: At the end of this unit, Student will be able to

1. Create various types DNA files and able to perform various types of operations on the files.
2. Develop programs to create, read, write DNA sequences in a file.

UNIT-II THE NCBI DATA MODEL: **10 periods**

Introduction, PUBs: Publications or Perish, SEQ-Ids: What's in a Name? , BIOSEQs: Sequences, BIOSEQ-SETs: Collections of Sequences, SEQ-ANNOT: Annotating the Sequence, SEQ-DESCR: Describing the Sequence. **(Text Book 1)**

Learning Outcomes: At the end of this unit, Student will be able to

1. Develop the program to download, read and process BIOSEQ files from NCBI .
2. Interpret the Annotations in BIOSEQs files.

UNIT-III **14 periods**

DNA as Data, Reading The DNA File, Reading The Bounds File, Examine The Data
DNA File Formats: FASTA Files, Genbank Files, Parsing The DNA String, Extracting Genes, Coding DNA
Computing GC Content: Parsing FASTA and Analyzing Sequences, Getting Started , Get Parsing FASTA Using Biopython, Iterating the Sequences Using a for Loop , Using a List, Using the filter() Function, Using the map() Function , Using Regular Expressions to Find Patterns. **(Text Book 2)**

Learning Outcomes: At the end of this unit, Student will be able to

1. Analyze various kinds of DNA files like FASTA Files, Genbank Files etc.
2. Develop the programs to parse and analyze the sequences of FASTA Files and Genbank Files using Biopython.

UNIT-IV **14 periods**

Sequence Alignment: Simple Alignment, Statistical Alignment, Brute Force Alignment, Dynamic Programming, Global and Local Alignments, Gap Penalties
CREATION AND ANALYSIS OF PROTEIN MULTIPLE SEQUENCE ALIGNMENTS:
Introduction, What is a Multiple Alignment, and Why Do It?, Structural Alignment or Evolutionary Alignment? , How to Multiply Align Sequences, Tools to Assist the Analysis of Multiple Alignments , Collections of Multiple Alignments **(Text Book 2)**

Learning Outcomes: At the end of this unit, Student will be able to

1. Describe different kinds of DNA sequence alignments.
2. Use advanced tools to explain the analysis of single alignment and multiple alignments of DNA sequences.

UNIT-V **10 periods**

Clustering, Purpose of Clustering, k-Means Clustering, More Difficult Problems, Dynamic k-means, Comments on k-means. **(Text Book 2)**

Learning Outcomes: At the end of this unit, Student will be able to

1. Develop clustering techniques using python to group the DNA sequences.
2. Analyze the performance of the k-Means with other clustering techniques.

TEXT BOOK:

1. Andreas D. Baxevanis, B. F. Francis Ouellette, BIOINFORMATICS, "A Practical Guide to the Analysis of Genes and Proteins", 2nd Edition, John Wiely, 2004
2. Jason M. Kinser, "Computational Methods for Bioinformatics in Python 3.4", 3rd Edition, George Mason University, 2017
3. Ken Youens-Clark," Mastering Python for Bioinformatics, How to Write Flexible, Documented, Tested Python Code for Research Computing", 1st Edition, O'Reilly, 2021

REFERENCES:

1. Bryan Bergeron, "Bio Informatics Computing", 2nd Edition, Pearson Education, 2003.
2. Arthur M Lesk, "Introduction to Bioinformatics", 2nd Edition, Oxford University Press, 2019

Web Resources:

1. https://digitalworldbiology.com/bioinformatics-tutorials
2. https://sapac.illumina.com/science/technology/next-generation-sequencing/beginners/tutorials.html
3. https://bioinformatics.uconn.edu/resources-and-events/tutorials-2/
4. https://nptel.ac.in/courses/102106065

Prepared By

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Mr. S. Ratan Kumar, Associate Prof, Dept of CSE

HIGH PERFORMANCE COMPUTING	
CSE 412(C)	**Credits : 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basic fundamentals of Data Structures
- Knowledge on Computer Organization, Computer Networks
- Exposure to Programming skills in C/C++

Course Objectives:

- Introducing different parallel machines
- Describe high performance computing in the context of scientific computing.
- Understand the concepts of parallel processing as it pertains to high-performance computing

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Explain the benefits of Parallel Computing and different parallel computing platforms.
2.	Design efficient Parallel Algorithms for scientific computations.
3.	Program computers with shared memory architecture
4.	Use GPU Computing efficiently for scientific computations.
5.	Apply High Performance Computing to solve real world Problems.

Mapping of course outcomes with program outcomes:

Mapping		**PO**												**PSO**	
		1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO	1	3	3	3	1	-	-	-	-	1	-	-	1	2	1
	2	3	2	2	2	-	-	-	-	1	-	-	1	1	3
	3	3	3	2	2	2	1	-	-	1	-	-	-	2	1
	4	3	3	3	2	2	2	-	-	1	-	-	-	2	3
	5	3	3	3	3	-	2	-	-	1	-	1	1	2	2

SYLLABUS

UNIT I: Introduction: 10 Periods

Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Implicit Parallelism: Trends in Microprocessor Architectures, Dichotomy of Parallel Computing Platforms . (Text Book 1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the impact of Parallel Computing
2. Compare different Parallel Computing Platforms.

UNIT II: Principles of Parallel Algorithm Design: 12 Periods

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions. Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads Parallel Algorithm Models.

Analytical Modeling of Parallel Programs: Sources of Overhead in Parallel Programs Performance Metrics for Parallel Systems, the Effect of Granularity on Performance, Scalability of Parallel Systems. (Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Design parallel algorithms
2. Compare different variety of overheads associated with parallelism.

UNIT III: Programming Shared Address Space Platforms: 12 Periods

Thread Basics, Why Threads?, The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads Controlling Thread and Synchronization Attributes, Thread Cancellation. (Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Apply Shared address Space Programming
2. Develop programs using POSIX threads for high performance computing.

UNIT IV: GPU Computing: 15 Periods

Introduction: Heterogeneous Parallel Computing, Architecture of a Modern GPU, Why More Speed or Parallelism, SPEEDING UP REAL APPLICATIONS,

Data parallel computing: Data Parallelism, CUDA C Program Structure, A Vector Addition Kernel, Device Global Memory and Data Transfer, Kernel Functions and Threading, Kernel Launch, CUDA Thread Organization, Mapping Threads to Multidimensional Data.

Learning Outcomes: At the end of this unit, the students will be able to (Text Book2)

1. Explain the impact of GPUs for achieving high performance
2. Develop programs using CUDA threads for high performance computing.

UNIT V:

Case Studies **10 Periods**

Dense Matrix Algorithms: Matrix-Vector Multiplication, Sorting, Quick sort, Bubble Sort and its Variants, Parallel Depth-First Search. (Text Book1)

Learning Outcomes: At the end of this unit, the students will be able to

1. Multiply dense matrices in parallel.
2. Compare different parallel sorting algorithms.

Text Book:

1. Ananth Grama, George Karypis , Vipin Kumar, Anshul Gupta, "*Introduction to Parallel Computing*", 2nd edition , Addison Wesley publishers,2003
2. David B. Kirk and Wen-mei W. Hwu, Programming Massively Parallel Processors A Hands-on Approach, 3rd edition, MK Publishers,2016

Reference Book:

1. Gerassimos Barlas , " *Multicore and GPU Programming An Integrated Approach* " 1st Edition, MK Publishers,2015

Web Resources:

1. http://nptel.ac.in/courses/106108055/#
2. http://cs.nyu.edu/courses/fall10/G22.2945-001/lectures.html
3. http://www.hpc.cam.ac.uk/
4. http://www.hpc.cam.ac.uk/getting-help/introtohpc-course/view
5. https://hpc.llnl.gov/training/tutorials
6. https://www.wolfram.com/training/courses/hpc/
7. https://www.epcc.ed.ac.uk/online-courses/courses/online-courses/practical-introduction-hpc

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NEURAL NETWORKS AND DEEP LEARNING	
CSE412(D)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Linear Algebra, Calculus, Statistics, General Programming Concepts

Course Objectives:

- Explore the concepts of neural networks and deep learning
- Examine the usage of neural networks
- Describe the data needs of deep learning
- Apply the working knowledge of neural networks and deep learning
- Explore the parameters for different neural networks

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Compare the Artificial Neural Network & Biological Neural Network and identify the need for Activation functions.
2.	Identify the need of functional units and differentiate Feed Forward Neural Network and Feedback Neural Network
3.	Demonstrate the concept of Deep Neural Network and Analyze the optimization & regularization of Deep Neural Network
4.	Identify the need for convolutional neural network and Examine the Various Architectures of Convolution Neural Network
5.	Examine the Various Architectures of Recurrent Neural Networks

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	-	-	-	-	-	-	-	1	-	-	-	1
2	2	3	2	-	-	-	-	-	1	2	-	-	-	1
3	2	2	2	-	-	-	-	-	1	2	-	-	-	3
4	2	2	3	2	1	-	-	-	2	2	2	1	-	3
5	2	2	3	2	1	-	-	-	2	2	2	1	-	3

SYLLABUS

UNIT-I: **12 Periods**

BASICS OF ARTIFICIAL NEURAL NETWORKS:

Characteristics of Neural Networks: Features of Biological Neural Networks, Biological Neural Networks, Comparison of Artificial Neural Network and Biological Neural Network, Historical Development of Neural Network Principles, **Artificial Neural Networks:** Terminology, Models of Neuron, Basic Learning Laws, Applications of ANN, Pros and Cons of ANN, **Activation Functions:** Binary Step Function, Linear Activation, Non Linear Activation Functions.

Learning Outcomes: At the end of this unit, the students will be able to

1. Describe the concepts of neural networks.
2. Apply activation functions for different scenarios.

UNIT-II: **12 Periods**

Functional Units of ANN for Pattern Recognition Tasks: Pattern Recognition Problem, Basic Functional Units.

Feed forward Neural Network: Pattern Classification Network: Perceptron, Linear Inseparability: Hard Problems, Multilayer Feed forward neural network: Generalized Delta Rule-Back propagation learning

Feedback Neural Networks: Analysis of Linear Auto associative FF Networks, Hetero-Associative Neural Network, Hopfield Network, Bidirectional Associative Neural Models (BAM).

Learning Outcomes: At the end of this unit, the students will be able to

1. Identify the need of Functional Units for Pattern Recognition Tasks.
2. Explore the concepts of Feedforward and Feedback Neural Network

UNIT-III: **12 Periods**

Deep neural networks (DNNs): Perspectives and Issues of Deep Learning, Difficulty of training DNNs, Greedy layer wise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization)

Learning Outcomes: At the end of this unit, the students will be able to

1. Describe the concepts of Deep Neural Networks
2. Analyze the optimization and regularization methods of neural networks

UNIT-IV: **12 Periods**

Convolution Neural Network: From Fully-Connected Layers to Convolutions, Convolutions for Images, Padding and Stride, Multiple Inputs and Outputs Channels, Pooling, Different Deep Convolutional Neural Network Architectures-LeNet, VGG16

Learning Outcomes: At the end of this unit, the students will be able to

1. Describe the basic structure of convolutional neural network.
2. Analyze the Different CNN Architectures

UNIT-V: **12 Periods**

Recurrent Neural Networks:

Sequence Models, RNN, Back propagation Through Time.

Modern Recurrent Neural Network: GRU, LSTM, Bidirectional RNN, Encoder-Decoder Learning,

Generative Models: Boltzmann Machine, Restricted Boltzmann Machine, Generative Adversarial Network,

Learning Outcomes: At the end of this unit, the students will be able to

1. Describe the architecture of recurrent neural network.
2. Explore the concepts of Generative Models.

Text Books:

1. Yegnanarayana, B., "Artificial Neural Networks" PHI Learning Pvt. Ltd, 2009.(UNIT-I, UNIT-II)
2. Goodfellow, I., Bengio,Y., and Courville, A., "Deep Learning", MIT Press, 2016.(UNIT-III)
3. Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, "Dive into Deep Learning", 2021(UNIT-IV,UNIT-V)

Reference Books:

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, 2004.
2. Simon Haykin, "Neural Networks-A comprehensive Foundation" Second edition(UNIT-I)
3. Charu C. Aggarwal, "Neural Networks and Deep Learning-A Textbook", Springer, 2018.

Web Resources:

1. https://www.analyticsvidhya.com/blog/2021/10/a-comprehensive-guide-on-deep-learning-optimizers/(UNIT-III)
2. https://www.analyticsvidhya.com/blog/2018/04/fundamentals-deep-learning-regularization-techniques//(UNIT-III)
3. https://www.analyticsvidhya.com/blog/2021/05/a-comprehensive-tutorial-on-deep-learning-part-1//(UNIT-III)
4. Michael Nielsen, Neural Networks and Deep Learning, http://neuralnetworksanddeeplearning.com/
5. Introduction to Deep Learning, MIT 6.S191 Alexander Amini January 28, 2019, http://introtodeeplearning.com/

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INTERNET OF THINGS	
CSE413(A)	**Credits: 3**
Instruction:3 Periods /Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites: Computer Network

Course Objectives:

1. Assess the genesis and impact of IoT applications, architectures in real world.
2. Illustrate diverse methods of deploying smart objects and connect them to network.
3. Compare different Application protocols for IoT.
4. Infer the role of Data Analytics and Security in IoT
5. Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry.

Course Outcomes:

By the end of the course, the student will be able to:	
1	Discuss the foundations of IoT, challenges and issues, architectures and its functionality
2	Apply and use of Sensors, actuators and its connected components in designing models
3	Explain various protocols and configurations of IoT and discuss different layers and its protocols.
4	Discuss the need data analytics and cloud services in order to transform the data through IoT to Data storage media.
5	Design and build the real-time applications(Smart applications).

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	1	2	2	2	-	-	-	-	1	1	-	-	2	-
	2	1	2	2	2	2	-	-	-	1	1	-	-	2	-
	3	1	2	2	2	2	-	-	-	1	1	-	-	2	-
	4	1	2	2	2	2	-	-	-	2	2	-	-	2	-
	5	1	3	3	3	3	-	-	-	2	2	-	-	3	-

SYLLABUS

UNIT I: **12 Periods**

What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss what IoT is and how it works today
2. analyze the factors that contributed to the emergence of IoT

UNIT II: **12 Periods**

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

Learning Outcome: At the end of this Unit the students will be able to

1. Analyze and discuss the deployment of sensors and its connected components and technologies to connect them to the network.
2. Build IoT models by connecting with IoT components and case study.

UNIT III: **12 Periods**

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss the role of IoT protocols for efficient network communication.
2. Apply the Protocols for developing the applications.

UNIT IV: **12 Periods**

Data and Analytics for IoT, An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT.

IoT Cloud Platform: Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/Services, Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits.

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss the need for Data Analytics and data streaming tools in IoT
2. Analyze and apply the Cloud platform in connection with IoT tools.

UNIT V: **12 Periods**

IoT Physical Devices –Micro Controllers
Arduino UNO: Introduction to Arduino, Installation, Fundamentals of Arduino Programming.
ESP8266: Introduction, Installation, Python Programming with ESP8266 using sensors.
Raspberry Pi: Introduction, Hardware and Software Layout, Configuration, Basic Raspberry Pi Programming with Python.

Learning Outcome: At the end of this Unit the students will be able to

1. Explain different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.
2. Choose the sensors and actuators for designing IoT applications.

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)

Reference Books:

1. Adrian McEwen,"Designing the Internet of Things", Wiley Publishers,2013,ISBN: 978-1-118-43062-0
2. Daniel Kellmereit, "The Silent Intelligence: The Internet of Things". 2013, ISBN 0989973700
3. Srinivasa K G, "Internet of Things", CENGAGE Leaning India, 2017
4. Enabling things to talk – Designing IoT solutions with the IoT Architecture Reference Model, Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange, Stefan Meissner, Springer

ONLINE WEB RESOURCES:

https://www.coursera.org/specializations/iot

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AUGMENTED REALITY	
CSE 413(B)	**Credits : 3**
Instruction **:** 3 Periods /Week	Sessional Marks : 40
End Exam : 3 Periods	End Exam Marks : 60

Prerequisites:

- Basic knowledge on C and C++
- Basic knowledge on computer graphics Basic mathematical knowledge

Course Objectives:

- To make the candidate understand the importance of augmented reality and its future as an aiding tool
- To check out various hardware and software components for augmented reality applications.
- Learn to build different types of objects that can act as contents for augmented reality.
- To understand various application like of augmented reality and build a small application that works on AR Marker or QR Code.

COURSE OUTCOMES:

By the end of the course, the student will be able to:	
1.	Explain augmented reality , technologies and its working functionalities.
2.	Use different hardware and software components to build an augmented reality application.
3.	Design 3D or 2D objects that can act as contents for augmented reality application and also to make these objects interact with the real world.
4.	Build a small mobile augmented reality app that works on AR Marker.
5.	Develop various applications in augmented reality.

Mapping of Course Outcomes with Program Outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	-	-	-	-	2	2	-	1	-	-	2	1	3
2	2	-	3	3	3	1	-	-	2	-	1	1	-	3
3	3	-	2	1	3	-	-	-	-	-	1	-	-	3
4	2	2	2	2	3	-	-	-	1	-	-	2	-	3
5	3	-	3	2	1	-	-	-	-	-	-	1	-	3

SYLLABUS

Unit 1 **10 periods**

Argument that reality: Introduction, origins of augmented reality, explanation of augmented reality with different scenarios, relationship between augmented reality and other technologies.
Augmented reality concepts: Introduction, how does augmented reality work, concepts related to augmented reality, ingredients of an argument reality experience?
Learning Outcomes: At the end of this unit, Students are able to

1. Explain the origin and history of the augmented reality.
2. Compare the relationship between augmented reality and other related techniques like Multimedia, 3D-Modelling, Real-time Tracking and Registration, Intelligent Interaction, Sensing

Unit 2 **14 periods**

Augmented reality hardware and software: Introduction, major hardware components for argument a reality systems, major software components for argument that reality systems, software is used to create content for augmented reality applications.
Learning Outcomes: At the end of this unit, Students are able to

1. Discuss about hardware and software components used in AR.
2. Describe the software involved directly with the AR application include environmental acquisition (sensors), sensor integration, application engine, and rendering software (visual, audio, etc.).

Unit 3 **14 periods**

Augmented reality content and interaction in Augmented reality: what is content, creating visual content like 3-D dimensional objects and today dimensional images, interaction in the real world, Manipulation, navigation.
Learning Outcomes: At the end of this unit, Students are able to

1. Explore the meaning of interaction and how it is carried out in AR environments.
2. Compares interaction in AR with interaction in other interactive media and how that affects participant expectations in AR environments.

Unit 4 **10 periods**

Mobile augmented reality: Introduction, what is mobile augmented reality, advantages and disadvantages of mobile augmented reality.
Learning Outcomes: At the end of this unit, Students are able to

1. Describe the technologies involved in mobile AR and different architectures for supporting mobile AR.
2. Explain the idea of mobile augmented reality.

Unit 5 **12 periods**

Augmented reality applications: Introduction, what makes a good documented reality application, application areas.

Learning Outcomes: At the end of this unit, Students are able to

1. Illustrate different application areas as well as different application styles.
2. List and explain different augmented reality applications.

TEXT BOOKS:

1. Alan B Craig, "Understanding Augmented Reality – Concepts and Applications" , 1st Edition, Elsevier Publications,2013

REFERENCES BOOKS:

1. Gregory Kipper," Augmented Reality – An Emerging Technologies Guide to AR", Elsevier Publications,2012.

Web Resources:

1. file:///C:/Users/DELL/Desktop/Syllabus%20comparision/CSE-IVYearAutonomoussyllabus.pdf

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SEMANTIC WEB	
CSE413(C)	**Credits: 4**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basic knowledge on Java, web technologies, mathematical knowledge

Course Objectives:

- To make the student understand the importance of semantic web and its role in making the web intelligent.
- To learn various concepts of semantic web like ontologies, RDF, RDF schema and OWL.
- Learn to build an ontology model for semantic web using different tools like protégé, jena ontology framework etc.,
- To understand various applications like software agents and semantic desktop

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Interpret the semantic web and its importance
2.	Differentiate between taxonomies, thesauri and ontologies along with gaining knowledge on rules for building ontologies.
3.	Describe a resource using RDF format along with working on RDF schema,OWL, and developing the inference rules using rule languages.
4.	Build an ontology model using the tools like protégé, Jena ontology framework.
5.	Develop an application of semantic web like semantic desktop with limited functionality.

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	1	-	-	-	-	2	2	-	1	-	-	2	-	2
	2	2	-	-	-	2	1	-	-	2	-	1	1	-	3
	3	3	-	2	-	1	-	-	-	-	-	1	-	-	3
	4	2	2	2	2	3	-	-	-	1	-	-	2	-	2
	5	3	-	3	2	1	-	-	-	-	-	-	1	-	3

SYLLABUS

UNIT 1 **10 Periods**

Introduction to semantic Web: the syntactic web, the semantic Web, how was the semantic Web will work, what the semantic Web is not, what will be the side effects of the semantic Web.

Learning Outcomes: At the end of this unit, the students will be able to

1. Compare syntactic web and semantic web and relate working process of the semantic web
2. Summarize the side effects of the semantic web.

UNIT 2 **12 Periods**

Introduction to ontology in computer science: defining the term ontology, differences among taxonomies, thesauri and ontologies, classifying ontologies, web ontology description languages.

Knowledge representation in description logic: introduction, and informal example, the family of attributive languages, inference problems.

Learning Outcomes: At the end of this unit, the students will be able to

1. Classify various ontologies and compare among different taxonomies.
2. Determine knowledge representation in description logic with examples.

UNIT 3 **14 Periods**

RDF and RDF schema: introduction, XML essentials, RDF, RDF schema and its vocabulary.

OWL: introduction, requirements for web ontology description language, header information versioning and annotation properties, properties, classes, individuals, data types.

Rule languages: introduction, usage scenarios for rule language, datalog, ruleml, swirl, triple.

Learning Outcomes: At the end of this unit, the students will be able to

1. Demonstrate working process of RDF.
2. Examine requirements of web ontology and scenarios for rule languages.

UNIT 4 **12 Periods**

Methods for ontology development: introduction, Uschold and King Ontology development method, Toronto virtual enterprise method, methontology, lexicon based ontology development method.

Ontology sources: introduction, metadata, upper ontologies.

Semantic Web software tools: introduction meta data and ontology editors like Dublin core metadata editor, OliEd, protégé ontology editor.

Learning Outcomes: At the end of this unit, the students will be able to

1. Apply various methods to develop web ontology.
2. Develop an ontology models using various semantic tools.

UNIT 5 **12 Periods**

Software agents: introduction, agent forms, agent architecture, agents in semantic Web context.

Semantic desktop: introduction, semantic desktop metadata, semantic desktop ontologies, semantic desktop architecture, semantic desktop related applications

Learning Outcomes: At the end of this unit, the students will be able to

1. Illustrate agent forms, agent architecture in semantic web context.
2. Determine semantic desktop metadata, desktop ontologies for semantic desktop related applications.

TEXT BOOKS:

1. Karin K Breitman,Marco Antonio Casanova,Walter Truszkowski," SemanticWeb – Concepts, Technologies and Applications", Springer 2007.

REFERENCES BOOKS:

1. Grigoris Antoniou, Frank van Harmelen," A Semantic Web Primer", 2nd Edition, MIT Press,2008.

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MULTIMEDIA & ANIMATION	
CSE 413(D)	**CREDITS:3**
INSRUCTION: 3 Periods /Week	**SESSIONAL MARKS: 40**
FINAL EXAM: 3Hours	**FINAL EXAM MARKS: 60**

Pre requisites: Computer Graphics, C Programming

Course Objectives:

The focus of the course is the

- To use different compression techniques during multimedia application development.
- Create, manipulate and incorporate multimedia building blocks.
- Understand and apply theoretical considerations and practical knowledge of the multimedia development process.
- Use Action Script 3.0 to develop interactive multimedia applications.

Course Outcomes:

By the end of the course Students will be able to

1. Discuss fundamental concepts of multimedia.
2. Identify different issues in multimedia data communication and storage.
3. Use action script programming skills required for development of different multimedia applications.
4. Apply different animation techniques.
5. Create animations using FLASH animation software.

CO-PO Table

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	1	1	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	1	1	1	1	-	-	-	-	1	1	-	1	-	2
CO 3	1	1	2	1	-	-	-	-	2	1	-	1	-	2
CO 4	1	1	2	1	-	-	-	-	2	1	-	1	-	2
CO 5	1	1	2	1	-	-	-	-	2	1	-	1	-	2

SYLLABUS

UNIT-I **13 Periods**

Introduction To Multimedia: What is Multimedia? Multimedia and Hypermedia, World Wide Web, Overview of multimedia Software Tools. Graphics and Image Data Representations: Graphics/Image Data Types.
Action Script 3.0 Core Concepts: Tools for writing action script code, Flash client runtime environments, compilation, just in time compilation, classes and objects, creating a program, packages, defining a class, variable and values, constructor parameters and arguments.
Color in Image and Video: color science, color models in images, color models in video.
Action Script 3.0 Conditionals, Loops and Functions: conditionals, loops, Boolean logic. Functions: package-level functions, nested functions, source-file-level functions, accessing definitions from within a function, functions as values.
Learning Outcomes: At the end of this unit the students will be able to

1. Discuss gain knowledge on multimedia and different colour models
2. Learn action script programming skills required for development of multimedia applications.

UNIT- II **12 Periods**

Fundamental Concepts in Video and Digital Audio: Types of video signals, analog video, digital video, digitization of sound, MIDI, quantization and transmission of audio.
Action Script 3.0 Data Types and Type Checking: Data types and type annotations, un typed variables, parameters, return values, strict modes three special cases, warnings for missing type annotations, detecting reference errors at compile time, casting, conversion to primitive types, default variable values, null and undefined.
Learning Outcomes: At the end of this unit the students will be able to

1. Discuss the digital and analog working of a video
2. Apply the techniques for digitization of sound.

UNIT-III **12 Periods**

Multimedia Data Compression: Lossless compression algorithms: Run-Length Coding, Variable Length Coding, and Dictionary Based Coding. Lossy compression algorithms: Quantization, Transform Coding, Wavelet-Based Coding.
Basics of Video Compression: Introduction to Video Compression, Video Compression with Motion Compensation, Search for Motion Vectors
Learning Outcomes: At the end of this unit the students will be able to

1. Identify different data compression techniques and explore them.
2. Apply the video compression techniques and explore it.

UNIT-IV **10 Periods**

Animation: What is mean by Animation – Why we need Animation – History of Animation– Uses of Animation – Types of Animation – Principles of Animation – Some Techniques of Animation – Animation on the WEB – 3D Animation – Special Effects -Creating Animation.
Learning Outcomes: At the end of this unit the students will be able to

1. Explain the basics of animation

2. Apply the different techniques in animation

UNIT-V **10 Periods**

Creating Animation in Flash: Introduction to Flash Animation – Introduction to Flash – Working with the Timeline and Frame-based Animation - Working with the Timeline and Tween-based Animation – Understanding Layers – Action script.

Learning Outcomes: At the end of this unit the students will be able to

1. Identify different techniques in Flash Animation
2. Apply the animation techniques to create animation

Text Books:

1. Ze-Nian Li and Mark S.Drew, *"Fundamentals of Multimedia"*, 1st Edition, PHI/Pearson Education,2009.
2. Colin Moock, *"Essential ActionScript 3.0"*, 1st Edition, SPD O'Reilly, 2007.
3. Flash CS4 Professional Bible Published by Wiley Publishing (Robert R & Snow D.
4. FLASH MX For PC/Mac Published by – FIREWALL MEDIA – Laxmi Publications

Reference Books:

1. Nigel Chapman and Jenny Chapman, "Digital Multimedia", 3rd Edition, Wiley Dreamtech, 2009.
2. Steve Heath, "Multimedia and Communications Technology", 2nd Edition, Elsevier (Focal Press), 1999.
3. Steinmetz, Ralf, Nahrstedt, "Multimedia Applications", 1st Edition, Springer, 2004.
4. Weixel, "Multimedia Basics", 2nd Edition, Thomson Press, 2006.

Online Resources:

1. MSIT121D_Multimedia_and_Animation.pdf - 1 MSIT-121D(Elective 2 Multimedia and Animation 2 Course Design and Editorial Committee Prof M.G.Krishnan Vice | Course Hero
2. INTRODUCTION TO MULTIMEDIA (ftms.edu.my)
3. History of Animation (kanpuruniversity.org)

PRINCIPLES OF MANAGEMENT AND FINANCIAL ACCOUNTING	
CSE 414	**Credits : 3**
Instruction **:** 3 Periods /Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Course Objectives: The course should enable students to

- To familiarize the students with the concepts of Management.
- To gain basic understanding of authority and manage organizations effectively
- To help the students to understand the concept Human Resource Management
- To evaluate the concepts of costs and its evaluation.
- To evaluate the basics of Final Accounting and determine the profitable status and financial position of the firm.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	**Analyse** the concepts of Management
2.	**Analyse** the difference between Authority Delegation and Decentralization
3.	**Develop** the understanding of the concept of human resource management and to understand its relevance in organizations.
4.	**Evaluate** different types of cost and **Apply** the concepts of Break-Even Analysis in **evaluating** project economically
5.	**Apply** the basic concepts of accounting, finance

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	-	-	-	-	-	-	-	-	**1**	-	**2**	**2**	-	-
	2	-	-	-	-	-	-	-	-	**1**	-	**2**	**2**	-	-
	3	-	-	-	-	-	-	-	-	**1**	-	**2**	**2**	-	-
	4	-	-	-	-	-	-	-	-	-	-	**3**	**2**	-	-
	5	-	-	-	-	-	-	-	-	-	-	**3**	**2**	-	-

SYLLABUS

UNIT 1: INTRODUCTION TO MANAGEMENT 12 periods

Definition and importance of Management. Management Functions or the Process of Management, Roles of a Manager, Levels of Management, Managerial Skills. Scientific Management and Administrative Management.

Learning Outcomes: At the end of this Unit the student will be able to

1. Describe what management is
2. Analyse the basic functions to be performed by management of any nature.

UNIT 2:AUTHORITY DELEGATION AND DECENTRALIZATION 12 periods

Meaning of Authority, Difference between Authority and Power, Meaning of Delegation of Authority- Advantages and Barriers to Effective Delegation. Decentralization of Authority Meaning, Distinction between Delegation and Decentralization, Advantages of Decentralization.

Learning Outcomes: At the end of this Unit the student will be able to

1. Analyse different types of authority
2. Differentiate authority delegation and decentralization

UNIT 3: HUMAN RESOURCE MANAGEMENT 10 periods

Definition of Human Resource Management, Roles of a Personnel Manager, Qualities of Personnel Manager, Functions of Human Resource Management – Planning, Organizing, Staffing, Motivating, Controlling and performance appraisal.

Learning Outcomes: At the end of this Unit the student will be able to

1. **E**ffectively manage and plan key human resource functions within organizations
2. Identify the significance of the performance appraisal in the organization.

UNIT 4: COST ANALYSIS AND BREAK-EVEN ANALYSIS 12 periods

Definition of Cost, the Concept and Nature of Cost, Break-Even-Analysis Introduction, Key terms used in Break-Even-Analysis, Graphical Representation-its assumptions, application and Limitations. (Simple problems).

Learning Outcomes: At the end of this Unit the student will be able to

1. Identify different types of costs
2. Analyse the concept of Break-Even Analysis and decide the project in an economical way

UNIT 5: INTRODUCTION TO FINANCIAL ACCOUNTING 14 periods

Final Accounts- Trading Account, Statement of Profit and Loss and Balance Sheet (with simple adjustments).

Learning Outcomes: At the end of this Unit the student will be able to

1. Assess the types of final accounts and rules governing the same

2. Analyze and evaluate how to calculate the profit/loss and the financial position of the firm.

TEXTBOOK:

1) Principles of Management, P.C.Tripathi and P.N.Reddy, Tata McGraw-Hill
2) S.C. Sharma and Banga T. R., Industrial Organization & Engineering Economics, khanna Publications, Delhi-6, 2006
3) Managerial Economics and Financial Analysis, A.R. AryaSri, TMH Publications, new Delhi, 2014

REFERENCES:

1. Industrial Engineering and Management, O.P.Khanna, Dhanpat Rai Publications (P) Ltd., New Delhi-2, 2017-18

Prepared By
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DATA ANALYTICS	
Course Code: CSE415	Credits : 3
Instruction : 3 Periods /Week & 1 Tut/Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basics on Probability and statistics.
- Fundaments of Python programming.

Course Objectives:

- To familiarize with basics data analytics and data analytics in Python.
- Equip the students with core statistical models and visualization techniques to perform exploratory data analysis using Python.
- Exploring the importance of analysis of variance and multivariate analysis of variance (MANOVA) and implement them in Python with different kinds of data sets.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Explore the basic principles of data analytics for performing basic data analysis tasks
2.	Comprehend the data visualization types in Python for exploratory data analysis.
3.	Apply Simple Statistical Techniques for Univariate and Bivariate Analyses
4.	Analyze the nature and logic of the analysis of variance.
5.	Apply linear and multi linear regression models.

CO-PO Mapping:

S.No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1					1									
CO 2	2				1									
CO 3	1	2	1		1									
CO 4	1	1	1		1									
CO5	1	1	1		1									

SYLLABUS

UNIT-1 **12 periods**

Introduction and Overview of Applied Statistics: How Statistical Inference Works, Statistics and Decision-Making, Essential Philosophical Principles for Applied Statistics, Data Analysis, Data Science, Machine Learning, Big Data, Training and Testing Models: What "Statistical Learning" Means in the Age of Machine Learning and Data Science. Building a Data frame in Python: And Computing Some Statistical Functions, Importing a .txt or .csv File, Loading Data into Python, Creating Random Data in Python, Exploring Mathematics in Python, Statistical Analysis in Python.

Learning Outcome: At the end of this Unit the student will be able to

- Understand basics of data analytics including its role in other sub domains.
- Implement the few fundamental principles of data analytics using Python programming.

UNIT-2

12 periods

Visualization and Linear Statistical Models: Visualization in Python- Aim for Simplicity and Clarity in Tables and Graphs, What Do the Numbers Tell Us? Clues to Substantive Theory, The Scatter plot, Correlograms, Histograms and Bar Graphs, Heatmaps, Line Charts.

Learning Outcome: At the end of this Unit the student will be able to

- Apply the visualization models to better understand the data and untold patterns.
- Interpret the output of machine learning models by using visualization techniques.

UNIT-3 **12 periods**

Simple Statistical Techniques for Univariate and Bivariate Analyses: Pearson Product-Moment Correlation, A Pearson Correlation Does Not (Necessarily) Imply Zero Relationship, Spearman's Rho, Computing Correlation in Python, T-Tests for Comparing Means, Paired-Samples t-Test in Python, Binomial Test, The Chi-Squared Distribution and Goodness-of-Fit Test, Contingency Tables.

Learning Outcome: At the end of this Unit the student will be able to

- Apply the statistical techniques to test the hypothesis .
- Identify the relation between the significant attributes using correlation techniques.

UNIT-4 **10 periods**

Analysis of Variance (ANOVA): T-Tests for Means as a Special Case of ANOVA, Analysis of Variance (one-way classification), ANOVA in Python, Analysis of Variance (two-way classification), Evaluating Assumptions in ANOVA, Effect Size for Teacher, Factorial ANOVA, Statistical Interactions.

Learning Outcome: At the end of this Unit the student will be able to

- Understand the purpose of conducting analytical comparisons.
- Determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups using ANOVA.

UNIT-5 **10 periods**

Simple and Multiple Linear Regression: Regression, Regression in Python, The Least-Squares Principle, The Population Least-Squares Regression Line, The Population Least-Squares Regression Line, How to Assess Goodness of Fit?, R2 – Coefficient of Determination, Multiple Linear Regression, Multiple Regression in Python, Principal Components Analysis, PCA in Python, Exploratory Factor Analysis in Python. Cluster Analysis, K-Means Clustering Algorithm, K-Means Clustering Algorithm in Python.

Learning Outcome: At the end of this Unit the student will be able to

- Learn and appreciate why regression analysis is so central to visually all statistical models and how multilinear regression is different from linear regression.
- Implement PCA and other unsupervised models in Python and how to interpret results.

Text Book:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.
2. Research Methodology, C.R. Kothari, New Age International Publishers, Second Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

1. https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

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Prepared By
Dr. K. Prasad, Assistant Prof, Dept of CSE
Mr. R. S. Kiran, Assistant Prof, Dept of CSE
Mrs. V. Mamatha, Assistant Prof, Dept of CSE

CRYPTOGRAPHY & NETWORK SECURITY LAB	
CSE 416	**Credits : 1.5**
Instruction : 3 Hr lab/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- Basic knowledge of Computer Networks
- Exposure to Problem solving techniques and programming skills

Course Objectives:

- Introducing different tools related to Network Security.
- Introducing how to implement cryptographic algorithms in C/C++/Java.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Demonstrate the process of capturing Network traffic using tools(Ethereal,Wireshark,Tcpdump)
2.	Implement Cryptographic algorithms in C/C++/Java
3.	Build Secure communication channel for web communication.
4	Use tools nmap and IPtables for network security

Mapping of course outcomes with program outcomes:

Mapping		PO												PSO	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	1		1	2	2	3	-	-	-	2	-	2	-	2	1
	2	1	1	2	3	-	-	-	-	2	-	2	-	1	-
	3		1	2	3	-	-	-	-	3	-	2	-	2	1
	4		2	2	2	3	-	-	-	2	-	2	-	2	1

SYLLABUS

LIST OF EXPERIMENTS:

1. Working with Sniffers for monitoring network communication using
   a)Ethereal b)Wireshark c) Snort d) tcpdump
2. Implementation and Performance evaluation of various cryptographic algorithms in C/C++
   a)DES b)RSA
3. Using IP TABLES on Linux and setting the filtering rules
4. Using open SSL for the web server - browser communication
5. Configuring S/MIME for e-mail communication
6. Understanding the buffer overflow and format string attacks
7. Using NMAP for port monitoring
8. Secure Socket programming.

Case studies:

9. Study of GNU PGP.
10. Study Intrusion Detection Systems and Honey pots.

Text Books :

1. Robert Bragg,Mark Rhodes-Ousley,Keith Strassberg ,"The Complete Reference Network Security", 1st Edition, 2004, Mc Graw Hill India
2. Nitesh Dhanjani, Justin Clarke ,"Network Security Tools Writing, Hacking, and Modifying Security Tools", 2013 Edition, O'Reilly Media.
3. Nitesh Dhanjani ,"Linux and UNIX Security Portable Reference",1st Edition,2003, McGraw-Hill.

Reference Books:

1. AnkitFadia, "The Unofficial Guide to Ethical Hacking",Second edition(2006),Laxmi Publications

Web Resources:

1. https://www.udemy.com/courses/it-and-software/network-and-security/
2. https://online.stanford.edu/course/network-security

Prepared By
Mr. S. Ratan Kumar, Associate Prof, Dept of CSE

DATA ANALYTICS LAB	
Code: CSE 417	**Credits :1.5**
Instruction **:**3 Periods & 1 Tut/Week	Sessional Marks : 50
End Exam : 3 Hours	End Exam Marks : 50

Prerequisites:

- Basic knowledge on Probabilityandstatistics.
- Basics of Python Programming.

Course Objectives:

- To train the students to apply the principles of data analytics to analyze and effectively visualize the data.
- Train the students to gain the knowledge of computational statistical approaches and their application to a variety of datasets.
- Practical way ofUnderstanding the nature of analysis of variance and Multivariate statistical models.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Work with different IDE and Pythonnotebooks for mathematical, scientific applications and for data analysis.
2.	Explore Pandas, matplotlib and seaborn packages. Write example programs to visualize the data.
3.	Work with Linear Regression and Multiple Regression models in Python
4.	Understanding of the ANOVA that can used to test a given hypothesis and to verify the experimental results are significant.
5.	Work with Dimensionality reduction and clustering Python and interpret the results.

CO-PO Table

S.No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1	-	-	-	-	2	-	-	-	-	-	-	-	-	-
CO 2	1	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 3	1	1	1	-	1	-	-	-	-	-	-	-	-	-
CO 4	1	2	1	-	1	-	-	-	-	-	-	-	-	-
CO5	1	1	1	-	1	-	-	-	-	-	-	-	-	-

1. Python (Recap)
    a)Getting familiarity with Python IDE, Notebooks and Data structures.
2. Numpy:
    a) Create an ndarray from a list or a tuple object. Create a 1-dimensional or multi-dimensional array from the list objects as well as tuples.
    b) Apply standard Arithmetic operators such as addition and multiplication on each element of the ndarray.

3. Pandas:
    a) Create a Series object from a list, a numpy array, or a Python dictionary. Apply most of the numpy functions on the Series object.
    b) Create a DataFrame object (e.g., from a dictionary, list of tuples, or even numpy'sndarrays) and Apply arithmetic operations.

4. Statistical analysis:
    a) Use the Iris sample data, which contains information on 150 Iris flowers, 50 each from one of three Iris species: Setosa, Versicolour, and Virginica. Each flower is characterized by five attributes:sepal length in centimeters, sepal width in centimeters, petal length in centimeters, petal width in centimeters, class (Setosa, Versicolour, Virginica).

       Load a CSV data file into a Pandas DataFrame object: Write the Pandas code to read the CSV file and store them in a DataFrame object named data. Next, display the first five rows of the data frame.

    b) Compute various summary statistics from the DataFrame:For each quantitative attribute, calculate its mean, standard deviation, minimum, and maximum values.
       For the qualitative attribute (class), count the frequency for each of its distinct values, compute the covariance and correlation between pairs of attributes(multivariate statistics) and display the summary for all the attributes.

5.matplotlib and seaborn:
    a) Display the histogram for the sepal length attribute by discretizing it into 8 separate bins and counting the frequency for each bin.
    b) Create a boxplot to show the distribution of values for each attribute.
    c) For each pair of attributes, Create a scatter plot to visualize their joint distribution.
    d) Create a line chart to representthe object as a line and the distribution of values for each class with a separate color.

6. Preprocessing (For addressing the common data quality issues including noise, outliers, missing values, and duplicate data. Using dataset from the UCI machine learning repository containing information about breast cancer patients):

    a) According to the description of the data (https://archive.ics.uci.edu/ml/datasets/breast+cancer+wisconsin+(original), the missing values are encoded as '?' in the original data. Task is to convert the missing values to NaNs. Then count the number of missing values in each column of the data.

Observe which column contains missing values. Replace the column withmissing values by the median value of that column. Show the values before and after replacement as a subset of the data points and discard the data points that contain missing valuesby applying the dropna() function to the data frame.

b) Draw a boxplot to identify the columns in the table that contain outliers. To discard the outliers, compute the Z-score for each attribute and remove those instances containing attributes with abnormally high or low Z-score (e.g., if Z > 3 or Z <= -3).
c) Check for duplicate instances in the breast cancer dataset. Identify the duplicate rows and remove all the duplicate rows.

7. Regression:

a) Generate a random 1-dimensional vector of predictor variables, x, from a uniform distribution. The response variable y has a linear relationship with x according to the following equation: y = -3x + 1 + epsilon, where epsilon corresponds to random noise sampled from a Gaussian distribution with mean 0 and standard deviation of 1.

b) Illustrate how to use Python scikit-learn package to fit a multiple linear regression (MLR) model. Given a training set {X,y}, MLR is designed to learn the regression function $f(X,w)=X^Tw+w_0$ by minimizing the following loss function given a training *set* $\{X_i,y_i\}^N_{i=1}$:

$$L(y,f(X,w))=^N\sum_{i=1}\|(y_i-X_iw-w_0)\|^2,$$

where w (slope) and w_0 (intercept) are the regression coefficients.
Perform the following tasks:

- Split the input data into their respective training and test sets.
- Fit multiple linear regression to the training data.
- Apply the model to the test data.
- Evaluate the performance of the model.
- Postprocessing: Visualizing the fitted model.

8. Analysis of variance (ANOVA):
Create an artificial real-world scenario where ANOVA could be functional.
40 randomly chosen students from 3 different (let's say the USA, UK, and Germany) countries have participated in a 500m running competition and got their results with the means of ~74s,~88s,~84s, respectively. Determine if there is an actual (statistically significant) difference between these different students groups regarding their middle-distance running performance or by pure chance if we happened to select better or worse performing students from other countries.

a) Conduct the Python one way ANOVA using Statsmodels.
b) Conduct the Python two way ANOVA using Statsmodels.
c) Conduct the Python n- way ANOVA(MANOVA) using Statsmodels.

9. Dimensionality Reduction on TheIris dataset:
a) The Iris dataset represents 3 kind of Iris flowers (Setosa, Versicolour and Virginica) with 4 attributes: sepal length, sepal width, petal length and petal width.
Apply Principal Component Analysis (PCA) to identify the combination of attributes (principal components, or directions in the feature space) that account for the most variance in the data. Plot the different samples on the 2 first principal components.
b)Apply Linear Discriminant Analysis (LDA) to identify attributes that account for the most variance between classes.
10.Cluster analysis:
Perform k-means clustering on a toy example of movie ratings dataset.

a) Apply k-means clustering (with k=2) on the movie ratings data
b) Determine the number of clusters in the data, apply k-means with varying number of clusters from 1 to 6 and compute their corresponding sum-of-squared errors (SSE).

Text Books:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition,2003.

Web Resource:

http://www.cse.msu.edu/~ptan/dmbook/software/
https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

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INFORMATION RETRIEVAL SYSTEMS	
CSE 422(A)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Data Structures
- Relational Database Systems
- Big Data

Course Objectives:

- To analyze and apply the foundation aspects involved in search, index and retrieval of various kinds of data sources by applying Information Retrieval representation, tools, techniques and strategies.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Discuss the functional overview and capabilities of the Information Retrieval System
2.	Apply indexing and various types of data structures for Information Retrieval.
3.	Analyze and apply the Automatic Indexing and Clustering.
4.	Explain different user search techniques.
5.	Visualize the Information and retrieval of the Multimedia Information.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	1	1	-	1	1	-	-	-	-	1	1	1
2	2	2	2	2	1	2	1	1	-	-	-	2	1	2
3	1	2	2	2	1	2	1	1	-	-	-	1	1	2
4	1	1	1	1	1	1	1	1	-	-	-	1	1	1
5	1	1	1	1	2	1	1	1	-	-	-	2	1	1

SYLLABUS

UNIT-I: **12 Hours**

Introduction to Information Retrieval Systems: Definition of Information Retrieval System, Objectives of Information Retrieval Systems, Functional Overview, Relationship to Database Management System, Digital Libraries and Data Warehouses.

Information Retrieval System Capabilities: Search Capabilities, Browse Capabilities, Miscellaneous Capabilities, Z39.50 and WAIS Standards.

Learning Outcomes:

1. Able to represent Information Retrieval System.
2. Able to Demonstrate Information Retrieval System Capabilities.

UNIT-II: **12 Hours**

Cataloging and Indexing: History and Objectives of Indexing, Indexing Process, Automatic Indexing, Information Extraction

Data Structure: Introduction to Data Structure, Stemming Algorithms, Inverted File Structure, N-Gram Data Structures, PAT Data Structure, Signature File Structure, Hypertext and XML Data Structures, Hidden Markov Models

Learning Outcomes:

1. Able to apply indexing.
2. Able to implement different types of data structures.

UNIT-III: **12 Hours**

Automatic Indexing: Classes of Automatic Indexing, Statistical Indexing, Natural Language, Concept Indexing, Hypertext Linkages.

Document and Term Clustering: Introduction to Clustering, Thesaurus Generation, Item Clustering, Hierarchy of Clusters.

Learning Outcomes:

1. Able to apply Automatic Indexing.
2. Able to analyze Document and Term Clustering.

UNIT-IV: **12 Hours**

Search: Introduction, Similarity Measures and Ranking, Hidden Markov Models Techniques, Ranking algorithms, Relevance Feedback, Selective Dissemination of Information Search, Weighted searches of Boolean Systems, Multimedia Searching

User Search Techniques: Search Statements and Binding, Similarity Measures and Ranking, Searching the INTERNET and Hypertext.

Learning Outcomes:

1. Able to apply various searching techniques.
2. Able to analyze ranking.

UNIT-V: **12 Hours**

Information Visualization: Introduction to Information Visualization, Cognition and Perception, Information Visualization Technologies.

Text Search Algorithms: Introduction to Text Search Techniques, Software Text Search Algorithms, Hardware Text Search Systems.

Multimedia Information Retrieval: Spoken Language Audio Retrieval, Non-Speech Audio Retrieval, Graph Retrieval, Imagery Retrieval, Video Retrieval.

Learning Outcomes:

1. Able to use information visualization techniques.
2. Able to retrieve multimedia information.

Text Books:

1. Kowalski, Gerald, Mark T May bury: INFORMATION RETRIEVAL SYSTEMS: Theory and Implementation, Kluwer Academic Press, 1997.
2. Gerald Kowalski: INFORMATION RETRIEVAL Architecture and Algorithms.
3. Finding Out About: Search Engine Technology from a cognitive Perspective, by Richard, K. Belew, Cambridge University Press, 2000. (for Case Studies)

Reference Books:

1. Frakes, W.B., Ricardo Baeza-Yates: Information Retrieval data Structures and Algorithms, Prentice Hall, 1992.
2. Modern Information Retrieval by Yates Pearson Education.
3. Information Storage & Retrieval by Robert Korfhage –John Wiley & Sons.

Online Resources:

1. https://nlp.stanford.edu/IR-book/information-retrieval.html
2. https://resources.mpi-inf.mpg.de/d5/teaching/ss04/is04/links.htm
3. https://www.lisedunetwork.com/information-retrieval-syste/

Prepared By
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CYBER SECURITY	
CSE422(B)	**Credits : 3**
Instruction **:** 3 Periods/Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basic Knowledge of Data Communications, Computer Networks
- Knowledge of Operating Systems Windows, Linux and Programming Languages (C, C++)

Course Objectives:

- Introducing Cyber Security Concepts
- Giving basic exposure about Cyber Crimes
- Explaining tools used in Cyber Crimes
- Explaining Cyber Law present in the system.

Course Outcomes: By the end of the course, the student will be able to:

1. Explain about vulnerability scanning approaches and describe the functionality of different types of scanning and service tools.
2. Comprehend about networking layers and summarize the defence methodologies and its relevant tools functionality.
3. Describe and inspect web vulnerabilities through tools.
4. Comprehend the cybercrime scenario and recognize the appropriate cyber law.
5. Demonstrate the cybercrime scenario and solve the crime through investigation by applying ethical hacking mechanisms.

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	**2**	**2**	**2**	2	2	2	-	-	-	-	-	**2**	2	2
	2	**2**	**2**	**2**	2	2	2	-	-	-	-	-	**2**	2	2
	3	**2**	**2**	**3**	2	2	2	-	-	-	-	-	**2**	2	1
	4	**2**	**2**	**2**	2	2	2	-	-	-	-	-	**2**	2	1
	5	**2**	**2**	**2**	**3**	2	2	-	-	-	**2**	-	**2**	2	2

UNIT-I: Systems Vulnerability Scanning 10 Periods

Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning - Netcat, Socat, understanding Port and Services tools - Datapipe, Fpipe, Network Reconnaissance – Nmap,

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain ports and probes in detail.
2. Analyse tools usage of Metasploit and netcat

UNIT-II: Network Defence tools 8 Periods

Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. Snort: Introduction Detection System

Learning Outcomes: At the end of this unit, the students will be able to

1. Analyze filters and firewall.
2. Install NAT tool and port forwarding for the VPN.

UNIT-III: Web Application Tools 10 Periods

Scanning for web vulnerabilities tools: Nikto, W3af, HTTP utilities - Curl, OpenSSL and Stunnel, Application Inspection tools – Zed Attack Proxy, Sqlmap. Webgoat, Password Cracking and Brute-Force Tools – John the Ripper –installation and configuration.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain various scanning utilities and Curl and openssl
2. Analyze Brute-force tools.

UNIT-IV: Introduction to Cyber Crime Investigation and Ethical Hacking 10 Periods

Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics. Recognizing and Defining Computer Crime, Contemporary Crimes, Computers as Targets, Indian IT ACT 2000.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain about various cyber crimes.
2. Explain about IT ACT 2000.

UNIT-V: Introduction to Cyber Crime and law 12 Periods

Password Cracking tools , Key loggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.

Learning Outcomes: At the end of this unit, the students will be able to

1. Usage of password cracking tools.
2. Analyze working principles Trojan and backdoors.

Text Books:

1. Anti-Hacker Tool Kit (Indian Edition) by Mike Shema, Publication McGraw Hill.
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Nina Godbole and SunitBelpure, Publication Wiley

Reference Books :

1. The Complete Reference Network Security By Robert Bragg, Mark Rhodes-Ousley,KeithStrassberg, 1st Edition,McGraw Hill India (2004) Publication

Web Resources:

1. https://www.coursera.org/specializations/cyber-security
2. https://computersecurity.stanford.edu/

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SOCIAL NETWORK ANALYSIS	
CSE 422(C)	**Credits : 3**
Instruction **:** 3 Periods /Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basic Knowledge of Data structures& Algorithms, Computer Networks and Data communication

Course Objectives:

- Understand the functionality of a social network.
- Model and visualize the social network.
- Mine the users in the social network.

Course Outcomes: By the end of the course, the student will be able to:

CO1	Describe the internal components of the social network.
CO2	Develop the Model and visualize the social network.
CO3	Investigate the behavior of the users in the social network.
CO4	Analyze the opinion of the users connected to social network.
CO5	Interpret security and privacy issues in real social networking sites

CO-PO Mapping:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
	2	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**-**
	3	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**2**
	4	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**1**	**2**
	5	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**

SYLLABUS

UNIT-I **12periods**

Introduction: Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

Learning Outcomes: At the end of this unit, Student will be able to

1. Elaborate the functionality, properties and limitations of the social networks.
2. Design personal Blogs and online communities.

UNIT-II **12 periods**

Modeling And Visualization: Visualizing Online Social Networks - A Taxonomy of 26 Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

Learning Outcomes: At the end of this unit, Student will be able to

1. Analyze the graphical representation of various social networks.
2. Visualize and model Social Networks using different approaches.

UNIT-III **12 periods**

Mining Communities: Aggregating and reasoning with social network data- Advanced Representations - Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

Learning Outcomes: At the end of this unit, Student will be able to

1. Develop mining algorithms for social networks
2. perform mining on large social networks and illustrate the results

UNIT-IV **12 periods**

Text and Opinion Mining: Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

Learning Outcomes: At the end of this unit, Student will be able to

1. Apply text and Opinion Mining techniques on social Networks.
2. Explain sentiment analysis in the context of opinion mining and rule-based models.

UNIT-V **12 periods**

Privacy in online social networks: Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.
Tools: Gephi, Palladio, NodeXL
Learning Outcomes: At the end of this unit, Student will be able to

1. Elaborate the security and privacy levels of various social networks using network analysis tools.
2. Explain about trust models, attacks and its countermeasures on social networks.

TEXT BOOK:

1. Peter Mika, "Social Networks and the Semantic Web", 1st Edition, Springer, 2007.
2. BorkoFurht, "Handbook of Social Network Technologies and Applications", 1st edition, Springer, 2010

REFERENCES:

1. GuandongXu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", 1st Edition, Springer, 2011.
2. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 2010.
3. Ajith Abraham, Aboul Ella Hassanien, VáclavSnáel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2009.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc16_cs07/preview
2. https://gephi.org/
3. https://sites.google.com/a/umn.edu/social-network-analysis/home

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CLOUDCOMPUTING	
CSE422(D)	Credits:3
Instruction:3Periods/ Week	SessionalMarks:40
EndExam:3Hours	EndExam Marks : 60

Pre requisites:

- To undertake this course student must have basic understanding of DataCommunications, Operatingsystems and Networking Technologies.

Course Objectives:

- To make students understand with the fundamentals and essentials of Cloud Computing.
- To provide students a sound foundation of the Cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
- Toenablestudentsexploringsomeimportantcloudcomputingdrivencommercialsystems such as GoogleApps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

Course outcomes:

By the end of the course, the student will be able to:	
1	To be familiar with the basics, challenges, need of cloud computing.
2	Able to identify infrastructure of cloud.
3	Describe different cloud services.
4	Analyzing different cloud security fundamentals and risks.
5	Knowledge on software development, networking in cloud and exposure on various Cloud applications.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
2	2	3	2	2	2	-	-	-	-	-	2	1	2	1
3	3	3	2	2	1	1	-	-	1	-	2	1	2	1
4	2	3	3	2	1	-	-	-	1	-	2	1	2	1
5	2	3	2	2	1	1	1	-	1	-	2	1	2	1

SYLLABUS

UNIT-1 **10Periods**

Understanding Abstraction and Virtualization: Using Virtualization Technologies, Load Balancing and Virtualization, Understanding Hypervisors, Understanding Machine Imaging .

Capacity Planning: Capacity Planning, Defining Baseline and Metrics, Network Capacity

Learning Outcomes: At the end of this unit, the students will be able to

1. Explore virtualization methods.
2. Explain capacity planning.

UNIT-2 **12Periods**

Defining Cloud Computing:

Defining Cloud Computing, Cloud Type- The NIST model, The Cloud Cube Model, Deployment models,Servicemodels,CharacteristicsofCloudComputing-
Paradigmshift,Benefitsofcloudcomputing,Disadvantagesofcloud computing, Assessing the Role of Open Standards.

Cloud Architecture:

Cloud Computing Stack- Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud-Chromium OS: The Browser as an Operating System.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explainthecloudcomputingmodelanddiscusstheadvantagesanddisadvantagesofcloud.
2. Connect to the cloud equipped with knowledge on protocols and cloud platforms.

UNIT-3 **12Periods**

Cloud Computing Software Security Fundamentals: Cloud Security Services, Relevant Cloud Security Design Principles, NIST 33 Security Principles, Secure Cloud Software Testing, Testing for Security Quality Assurance, Cloud Penetration Testing

Cloud Computing Risk Issues: The CIA Triad, Privacy and Compliance Risks, Common Threats and Vulnerabilities, Cloud Access Control Issues, Cloud Service Provider Risks.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the cloud security services and differentiate testing mechanisms.
2. Explore the cloud risk issues.

Unit-4 **12Periods**

Using Platforms: Using Google Web Services, Using Amazon Web Services, Using Microsoft Cloud Services. Exploring Platform as a Service.

Learning Outcomes: At the end of this unit, the students will be able to

1. Use various cloud platforms
2. Explain platform as service

UNIT-5 **12Periods**

UnderstandingServicesandApplications: UnderstandingServiceOrientedArchitecture, Energy Moving Applications to the Cloud, Working with Cloud-Based Storage, Using Media and Streaming

Learning Outcomes: At the end of this unit, the students will be able to

1. Implement the cloud storage services for application development.
2. Explain media and streaming usage.

TEXTBOOKS:

1. "**CloudSecurityAComprehensiveGuidetoSecureCloudComputing**",RonaldL.Krutz Russell Dean Vines, Wiley Publishing, Inc (Unit-1: Unit-3: Chapter 3,4)
2. "**CloudComputingBible**",BarrieSosinsky,WileyIndiaPvt.Ltd,2013.
   (Unit-2 chapter:1,3)(Unit-4.Chapter:8,9,10) (Unit-5chapter: 13,14, 15,19)

REFERENCEBOOKS:

1. BuyyaR.,Broberg J.,GoscinskiA., "CloudComputing:PrinciplesandParadigms", JohnWiley&SonsInc.,
2. AnthonyT.Velte,TobyJ.Velte,RobertElsenpeter."CloudComputing-APracticalApproach",1stEdition, McGrawHill.
3. Cloudcomputingfordummies-JudithHurwitz, RobinBloor,MarciaKaufman,FernHalper,WileyPublishing,Inc, 2010.

WEBSOURCES:

1. http://www.tutorialspoint.com/cloud_computing/cloud_computing_tutorial.pdf
2. http://www.thbs.com/downloads/Cloud-Computing-Overview.pdf
3. https://www.priv.gc.ca/resource/fs-fi/02_05_d_51_cc_e.pdf4.Lewis,Grace.
4. http://www.sei.cmu.edu/library/abstracts/whitepapers/cloudcomputingbasics.cfm(2010).

Prepared By

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FOUNDATIONS OF LINUX	
CSE OE3(A)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Familiarity with the Linux command line.
- Knowledge of Linux simple commands.

Course Objectives:

- Memorize the basic concepts and commands to interact with Linux System and VI editor.
- Acquire the knowledge of Linux Operating System.
- Demonstrate various commands in Linux environment.
- Develop the ability to evaluate regular expressions and use them for pattern matching.
- Implement the SHELL script problems.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Describe history, origin, feature and architecture of Linux operating system.
2.	Interact with Linux system easily.
3.	Demonstrate various commands in Linux environment.
4.	Solve complex jobs using tools and utilities available in Linux.
5.	Design and develop various tasks by using Shell scripting.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	-	1	-	-	-	-	-	-	-	-	-	-	-
2	1	1	2	-	-	-	-	-	-	-	-	-	1	-
3	1	2	3	3	-	-	-	-	-	-	-	-	2	2
4	1	3	3	3	3	-	-	-	-	-	-	-	2	2
5	1	3	3	3	3	-	-	-	-	-	-	-	2	2

SYLLABUS

UNIT-I: **12 Periods**

Introduction: The History of Linux operating system, Linux and GNU, The Linux architecture, Internal and External commands, Command structure. Linux Features, Applications of Linux, Linux versions**.** **Basic Linux commands:** The parent – child relationship, the HOME variable, absolute pathname, relative pathname, PATH, man, echo, printf, script, passwd, uname, who, date, stty, pwd, cd, mkdir, rmdir, ls, cp, mv, rm, cat, more, wc, lp, od, tar, gzip.

Learning outcomes: The student will be able to

- Learn history, origin, feature and architecture of Linux operating system.
- Understand the Linux file system and the versions of Linux.

Unit – II: **12 Periods**

Vi editor: Basics, input mode, saving text and quitting, searching for a pattern (| and ?), substitution-search and replace(:s). Basic file attributes: ls: listing directory contents, the file system, ls –l, -d option, file ownership, file permissions, chmod, directory permissions, changing file ownership. More file attributes: File systems and inodes, hard links, symbolic links and ln, the directory, umask, modification and access times, find.

Learning outcomes: The student will be able to

- Interact with Linux file system easily.
- Work with data interpretation commands.

Unit– III **12 Periods**

Process basics: ps: process status, system processes(-e or –a), mechanism of process creation, understanding Linux process states and zombies, running jobs in background, nice and renice commands in Linux, job execution, job control. Simple filters: fmt, more, less, pr, head, tail, cut, paste, sort, uniq, tr. Filters using regular expressions – grep and sed: grep, Basic Regular Expressions (BRE), Extended Regular Expressions (ERE) and egrep.

Learning outcomes: The student will be able to

- Checks the process status and searches for any patterns using Linux regular expressions.
- Use Linux filters for data retrieval.

Unit – IV **12 Periods**

Filters Using Regular Expressions: sed: the stream editor, line addressing using multiple instructions (-E and -F) context addressing, writing selected lines to a file (w), text editing, substitution (s), basic regular expression revisited. **The shell:** The shell's interpretive cycle, shell offerings, pattern matching, escaping and quoting, redirection, pipes, tee, command substitution, shell variables.

Learning outcomes: The student will be able to

- Solve complex jobs using utilities available in Linux.
- Execute Shell programs with basic variables.

Unit – V **12 Periods**

Essential shell programming: Shell scripts, read using command line arguments $, exit and exit status ofcommand, the logical operators and ||, the if conditional, using test and {} to evaluate expression. The case conditional, expr, $0(calling a script by different names), while, for, debugging.

Learning outcomes: The student will be able to

- Design and develop various tasks by using Shell scripting.
- Work with command line arguments available in Linux.

Text Book:

1. SUMITABHA DAS, "Your LINUX – The ultimate Guide", TATA McGraw Hill Edition, 23rd reprint 2012, McGraw Hill.
2. N.Matthew, R.Stones, Wrox , "Beginning Linux Programming" , 4th Edition, Willey India Edition.

Reference Books:

1. Robert Love, O'Reilly, "Linux System Programming", 2nd Edition-2013, SPD.
2. W. Richard. Stevens, "Advanced Programming in the LINUX Environment", 3rd edition, Pearson Education, 2013, New Delhi, India.

E-Resources:

1. http://www.mhhe.com/das/uca
2. http://www.tutorialspoint.com/unix/unix_tutorials.pdf.
3. http://www.perldoc.perl.org/

INTRODUCTION TO DATA ANALYTICS	
CSE-OE3(B)	Credits : 3
Instruction : 3 Periods /Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Basics on Probability and statistics.
- Fundaments of Python programming.

Course Objectives:

- To familiarize with basics data analytics and data analytics in Python.
- Equip the students with core statistical models and visualization techniques to perform exploratory data analysis using Python.
- Exploring the importance of analysis of variance and multivariate analysis of variance (MANOVA) and implement them in Python with different kinds of data sets.

Course Outcomes:

By the end of the course, the student will be able to:

1.	Explore the basic principles of data analytics for performing basic data analysis tasks
2.	Comprehend the data visualization types in Python for exploratory data analysis.
3.	Apply Simple Statistical Techniques for Univariate and Bivariate Analyses
4.	Analyze the nature and logic of the analysis of variance.
5.	Apply linear and multi linear regression models.

CO-PO Mapping:

S.No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO1	PSO2
CO 1					1									
CO 2	2				1									
CO 3	1	2	1		1									
CO 4	1	1	1		1									
CO5	1	1	1		1									

SYLLABUS

UNIT-1 **12 periods**

Introduction and Overview of Applied Statistics: Essential Philosophical Principles for Applied Statistics, Data Analysis, Data Science, Machine Learning, Big Data, Training and Testing Models: What "Statistical Learning" Means in the Age of Machine Learning and Data Science.

Learning Outcome: At the end of this Unit the student will be able to

- Understand basics of data analytics including its role in other sub domains.
- Implement the few fundamental principles of data analytics using Python programming.

UNIT-2

12 periods

Visualization and Linear Statistical Models: Visualization in Python- Aim for Simplicity and Clarity in Tables and Graphs, What Do the Numbers Tell Us? Clues to Substantive Theory, The Scatter plot, Correlograms, Histograms and Bar Graphs, Heatmaps, Line Charts.

Learning Outcome: At the end of this Unit the student will be able to

- Apply the visualization models to better understand the data and untold patterns.
- Interpret the output of machine learning models by using visualization techniques

UNIT-3 **12 periods**

Simple Statistical Techniques for Univariate and Bivariate Analyses: Pearson Product-Moment Correlation, A Pearson Correlation Does Not (Necessarily) Imply Zero Relationship, Spearman's Rho, Computing Correlation in Python, T-Tests for Comparing Means, Paired-Samples t-Test in Python, Binomial Test, The Chi-Squared Distribution and Goodness-of-Fit Test, Contingency Tables.

Learning Outcome: At the end of this Unit the student will be able to

- Apply the statistical techniques to test the hypothesis .
- Identify the relation between the significant attributes using correlation techniques.

UNIT-4 **10 periods**

Analysis of Variance (ANOVA): T-Tests for Means as a Special Case of ANOVA, Analysis of Variance (one-way classification), ANOVA in Python, Analysis of Variance (two-way classification), Evaluating Assumptions in ANOVA, Effect Size for Teacher, Factorial ANOVA, Statistical Interactions.

Learning Outcome: At the end of this Unit the student will be able to

- Understand the purpose of conducting analytical comparisons.
- Determine whether there are any statistically significant differences between the means of three or more independent (unrelated) groups using ANOVA.

UNIT-5 **10 periods**

Simple and Multiple Linear Regression: Regression, Regression in Python, The Least-Squares

Principle, The Population Least-Squares Regression Line, The Population Least-Squares Regression Line, How to Assess Goodness of Fit?, R2 – Coefficient of Determination, Multiple Linear Regression, Multiple Regression in Python, Principal Components Analysis, PCA in Python, Cluster Analysis, K-Means Clustering Algorithm, K-Means Clustering Algorithm in Python.

Learning Outcome: At the end of this Unit the student will be able to

- Learn and appreciate why regression analysis is so central to visually all statistical models and how multilinear regression is different from linear regression.
- Implement PCA and other unsupervised models in Python and how to interpret results.

Text Book:

1. Applied Univariate, Bivariate, and Multivariate Statistics Using Python, Daniel J. Denis, Wiley, First Edition.
2. Research Methodology, C.R. Kothari, New Age International Publishers, Second Edition.

Reference Books:

1. Applied Multivariate Statistical Analysis, Richard. A. Johnson and Dean.W. Wichern, Pearson Prentice Hall, 6th Edition, 2007.
2. An Introduction to Multivariate Statistical Analysis, T.W. Anderson, Wiley, 3rd Edition, 2003.

Web Resource:

1. https://www.westga.edu/academics/research/vrc/univariate-bivariate-analyses.php

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CYBER FORENSICS	
CSE- OE3(C)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

- Knowledge of Operating Systems.
- Knowledge of Computer Networks.
- Students must have the basic knowledge of security concepts.

Course Objectives:

- Identify security risks and cyber risks.
- Gain in-depth knowledge about the investigation tools and techniques.
- Acquire the fundamentals of e-mail forensics.
- Analyse the data for evidence capturing process and investigation.
- Acquire the knowledge of cyber law and its importance.

Course Outcomes:

By the end of the course, the student will be able to:	
1.	Enumerate the cyber risks related to computer forensics fundamentals.
2.	Gain the knowledge of cyber forensic tools and techniques.
3.	Detect and analyse the cyber-crime using various tools.
4.	Implement the forensic investigation tools and the methods for data recovery.
5.	Identify the importance of Cyber law.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	1	1	2	3	3	1	-	-	-	-	-	-	-	-
2	1	2	3	3	3	-	-	-	-	-	-	-	2	2
3	1	3	2	3	3	-	-	-	-	-	-	-	-	2
4	1	2	3	3	3	-	-	-	-	-	-	-	-	2
5	-	-	-	1	-	2	-	3	-	-	-	-	-	-

SYLLABUS

UNIT –I: **12 Periods**

Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

Learning Outcomes: At the end of this unit, the student will be able to

1. Acquire the knowledge of cyber risks.
2. Memorize the concepts related to computer forensics and fundamentals.

UNIT –II: **12 Periods**

Tools and Methods : Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

Learning Outcomes: At the end of this unit, the student will be able to

1. Acquire the knowledge of cyber forensic tools.
2. Deploy the techniques to prevent cyber-attacks.

UNIT –III: **10 Periods**

Cyber Forensics: Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools.

Learning Outcomes: At the end of this unit, the student will be able to

1. Analyse and deploy the tools related to the evidences collected.
2. Investigate the issues related to cyber forensics.

UNIT –IV: **12 Periods**

Cyber Investigations: Validating and Testing Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

Learning Outcomes: At the end of this unit, the student will be able to

1. Implement the methods for data recovery and data seizure.
2. Validate the evidences related to the cyber-crime.

UNIT –V: **12 Periods**

Cyber Crime Legal Perspectives: Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

Learning Outcomes: At the end of this unit, the student will be able to

1. Acquire the knowledge of Cyber Laws related to our IT scenarios.
2. Acquire the knowledge about the vulnerabilities in Indian IT Act.

Text Books:

1. Sunit Belapure Nina Godbole "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", WILEY, 2011.

2. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

Reference Books:

1. Michael T. Simpson, Kent Backman and James E. Corley, "Hands on Ethical Hackingand Network Defence", Cengage, 2019.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media,New Delhi.
3. Alfred Basta, Nadine Basta,Mary Brown and Ravinder Kumar "Cyber Security andCyber Laws" , Cengage,2018.

Web Resources:

1. CERT-In Guidelines- http://www.cert-in.org.in/
2. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks [Online Course]
3. https://computersecurity.stanford.edu/free-online-videos [Free Online Videos]
4. Nickolai Zeldovich. 6.858 Computer Systems Security. Fall 2014. Massachusetts Institute of Technology: MIT OpenCourseWare, https://ocw.mit.edu. License: Creative Commons BY-NC-SA.

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CLOUDTECHNOLOGIES	
CSE- OE4(A)	**Credits:3**
Instruction:3 Periods/Week	SessionalMarks:40
End Exam :3 Hours	End Exam Marks : 60

Prerequisites:

- Basic understanding of data communications and operating systems.

Course Objectives:

- To make students understand with the fundamentals and essentials of Cloud Computing and how virtualization concepts.
- To provide students a sound foundation of the cloud computing so that they are able to start using and adopting Cloud Computing services and tools in their real life scenarios.
- To enable students exploring some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon Web Services and other businesses cloud applications.

Course outcomes:

By the end of the course, the student will be able to:	
1	To be familiar with network-centric computing, parallel and distributed systems.
2	Able to identify infrastructure of cloud and paradigms.
3	Describe cloud resource virtualization and networking support.
4	Analyzing cloud Management and Scheduling.
5	Knowledge on storage systems and cloud application development.

Mapping of course outcomes with program outcomes:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	-	-	-	-	-	-	-	-	-	-	1	1
2	2	3	2	2	2	-	-	-	-	-	2	1	2	1
3	3	3	2	2	1	1	-	-	1	-	2	1	2	1
4	2	3	3	2	1	-	-	-	1	-	2	1	2	1
5	2	3	2	2	1	1	1	-	1	-	2	1	2	1

SYLLABUS

UNIT-I: 11Periods

Introduction:
Network-CentricComputingandNetwork-CentricContent,Peer-to-PeerSystems,CloudComputingDeliveryModelsandServices,EthicalIssuesinCloudComputing,Cloud Vulnerabilities

Parallel and Distributed Systems:
ParallelComputing,ParallelComputerArchitecture,DistributedSystems,CommunicationProtocols and Process Coordination, Logical Clocks, Message Delivery Rules; Causal Delivery,Concurrency,AtomicActions,ConsensusProtocols,ModelingConcurrencywithPetriNets,EnforcedModularity: The Client-Server Paradigm.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the cloud computing network.
2. Explore parallel and distributed systems.

UNIT-II: 15Periods

Cloud Infrastructure:
Cloud Computing at Amazon, Cloud Computing: The Google Perspective, Microsoft Windows Azure and Online Services, Open-Source Software Platforms for Private Clouds, Cloud Storage Diversity and Vendor Lock-in, Cloud Computing Interoperability: The Inter cloud, Energy Use and Ecological Impact of Large-Scale Data Centers, Service- and Compliance-Level Agreements, Responsibility Sharing Between User and Cloud Service Provider, User Experience, Software Licensing.

Cloud Computing Applications and Paradigms:
Existing Cloud Applications and New Application Opportunities, Architectural Styles for Cloud Applications, Workflows: Coordination of Multiple Activities, The MapReduce Programming Model, High-Performance Computing on a Cloud,

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the cloud infrastructure.
2. Demonstrate the cloud applications.

UNIT-III: 12Periods

Cloud Resource Virtualization:
Virtualization,LayeringandVirtualization,VirtualMachineMonitors,VirtualMachines,Performance and Security Isolation, Full Virtualization and Para virtualization, Hardware SupportforVirtualization,APerformanceComparisonofVirtualMachines,TheDarkerSideofVirtualization,SoftwareFaultIsolation.

Networking Support:
Packet-Switched Networks, The Internet, Internet Migration to IPv6,The Transformation of the Internet, Web Access and the TCP Congestion Control Window, Network Resource Management, Interconnection Networks for Computer Clouds, Storage Area Networks.

Learning Outcomes: At the end of this unit, the students will be able to

1. Illustrates the virtualization concepts.
2. Explain the networking concepts.

UNIT-IV: **10Periods**

Cloud Resource Management and Scheduling:

Policies and Mechanisms for Resource Management, Applications of Control Theory to Task Scheduling on a Cloud, Stability of a Two-Level Resource Allocation Architecture, Feedback Control Based on Dynamic Thresholds, Coordination of Specialized Autonomic PerformanceManagers,AUtility-BasedModelforCloud-BasedWebServices,ResourceBundling:Combinatorial Auctions for Cloud Resources, Scheduling Algorithms for Computing Clouds, FairQueuing,Start-TimeFairQueuing,BorrowedVirtualTime,CloudSchedulingSubjecttoDeadlines, Scheduling MapReduce Applications Subject to Deadlines, Resource Management and Dynamic Application Scaling

Learning Outcomes: At the end of this unit, the students will be able to

1. Describe the concept of cloud resource management and scheduling.
2. Explore scheduling algorithms and Map reduce applications.

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UNIT-V: **15Periods**

Storage Systems:

Storage Models, File Systems, and Databases, Distributed File Systems: The Precursors, General Parallel File System, Google File System, Apache Hadoop, Transaction Processing and NoSQL Databases, BigTable, Megastore.

Cloud Application Development:

Amazon Web Services: EC2 Instances, Connecting Clients to Cloud Instances Through Firewalls, Security Rules for Application and Transport Layer Protocols in EC2, Launching an EC2 LinuxInstanceandConnecttoit,UsingS3inJava,InstallingtheSimpleNotificationServiceonUbuntu, Creating an EC2 Placement Group and Using MPI, Installing Hadoop on Eclipse on aWindowsSystem,Cloud-BasedSimulationofaDistributedTrustAlgorithm,ATrustManagementService.

Learning Outcomes: At the end of this unit, the students will be able to

1. Explain the cloud storage systems.
2. Utilize the cloud applications.

Text Books:

1. DanC. Marinescu,"CloudComputingTheoryandPractice*",*MKpublications.

Reference Books:

1. BuyyaR.,Broberg J.,GoscinskiA.,"Cloud Computing:PrinciplesandParadigms",JohnWiley&SonsInc.,
2. Cloudcomputingfordummies-JudithHurwitz,RobinBloor,MarciaKaufman,FernHalper,WileyPublishing,Inc, 2010.
3. **"**EssentialsofCloudComputing**",**K.Chandrasekaran,CRCpress.

Web Resources:

1. https://www.priv.gc.ca/resource/fs-fi/02_05_d_51_cc_e.pdf4.Lewis,Grace.
2. http://www.intel.in/content/dam/www/public/us/en/documents/guides/cloudcomputingvirtualization-building-private-iaas-guide.pdf

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INTRODUCTION TO SOFTCOMPUTING	
CSE-OE4(B)	**Credits: 3**
Instruction : 3 Periods / Week	Sessional Marks : 40
End Exam : 3 Hours	End Exam Marks : 60

Prerequisites:

Knowledge on

- Probability and Statistics,
- Data Structures and Algorithms ,
- Artificial Intelligence

Course Objectives:

The course should enable the students:

- To discuss about the Basic principles, techniques, and applications of Soft Computing.
- To analyze and apply the insights into soft computing techniques to apply in Science and Engineering domains in order to solve real-time problems.

Course Outcomes

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

CO1	Discuss the fundamental concepts of Hard Computing and Soft Computing and its importance, , Applications of Soft Computing, case studies
CO2	Demonstrate the basic concepts of Fuzzy sets and Fuzzy logic and its applications.
CO3	Apply single-objective optimization problems using GAs
CO4	Discuss and apply foundations of artificial neural networks and multi-objective optimization problems.
CO5	Illustrate different hybrid models of Soft Computing and Applications to solve problems in varieties of application domains.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES:

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	1	1	-	-	1	1	1	1	1	2	-	1
2	2	2	2	2	-	1	1	1	-	1	1	1	1	1
3	2	2	2	2	-	1	1	1	-	1	1	2	2	2
4	2	2	2	2	1	1	1	1	-	1	1	1	1	2
5	2	1	2	2	1	2	1	1	1	1	2	1	1	2

SYLLABUS

Unit 1: **10 Periods**

Introduction to Soft Computing

Introduction to Soft Computing, Soft Computing versus Hard Computing, Characteristics of Soft Computing, Requirements of Soft Computing, Areas of Soft Computing, Applications of Soft Computing.

Learning Outcomes: At the end of this unit, Student will be able to

1. Discuss foundations of soft computing and its importance
2. Explain the functional characteristics and requirements of Soft Computing and its applications.

Unit 2: **10 Periods**

Fuzzy Sets and Fuzzy Logic:

Introduction to Fuzzy sets, Fuzzy versus Crisp sets, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Min-Max Composition, Defuzzification techniques, Fuzzy logic controller design, Fuzzy Rule-based Systems, Fuzzy Decision Making, Fuzzy Control Systems, Fuzzy Classification, Applications of Fuzzy logic and Fuzzy Systems.

Learning Outcomes: At the end of this unit, Student will be able to

1. Discuss fundamental concepts of Fuzzy logic and its functional operations.
2. Explain classification of fuzzy logic methods and its applications.

Unit 3: **10 Periods**

Genetic Algorithms:

Introduction to Genetic Algorithms, Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc, Solving single-objective optimization problems using GAs, Introduction to Genetic Programming.

Learning Outcomes: At the end of this unit, Student will be able to

1. Discuss foundations of Genetic Algorithm and its basic operations, Genetic Programming
2. Apply to solve single-objective optimization problems using GA

Unit 4: **10 Periods**

Artificial Neural Networks and Multi-Objective Optimization Problem Solving:

Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real life problems.

Concept of multi-objective optimization problems (MOOPs) and issues of solving them, Multi-Objective Evolutionary Algorithm (MOEA), Non-Pareto approaches to solve MOOPs, Pareto-based approaches to solve MOOPs, Some applications with MOEAs.

Learning Outcomes: At the end of this unit, Student will be able to

1. Explain fundamental concepts of artificial neural networks and its architectures.
2. Discuss the concept of Multi-objective optimization problems and its approaches.

Unit 5: **10 Periods**

Hybrid Systems:

Introduction to Hybrid Systems, Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

Learning Outcomes: At the end of this unit, Student will be able to

1. Discuss foundations of hybrid systems and its types
2. Apply hybrid techniques on real-time problems/ complex problems.

Textbooks:

1. S. Rajasekaran, and G. A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logis and Genetic Algorithms : Synthesis, and Applications, Prentice Hall of India, 2007.
2. D. K. Pratihar , Soft Computing , Narosa, 2008
3. F. Martin, , Mc neill, and Ellen Thro, Fuzzy Logic: A Pratical approach, AP Professional, 2000.
4. David E. Goldberg Genetic Algorithms In Search, Optimization And Machine Learning, Pearson Educaion, 2002.

Reference books:

1. Timothy J. Ross , Fuzzy Logic with Engineering Applications (3rd Edn.), Willey, 2010.
2. Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, MIT Press, 1998.
3. Nikola K. Kasabov, Fuzzy Logic for Embedded Systems Applications, Ahmed M. Ibrahim, Elesvier Press, 2004.
4. Melanie Mitchell, An Introduction to Genetic Algorithms, MIT Press, 2000.
5. Randy L. Haupt and sue Ellen Haupt, Practical Genetic Algorithms, John Willey & Sons, 2002.
6. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, Neuro-Fuzzy and soft Computing, PHI Learning, 2009.

Online Resources:

1. http://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html
2. https://nptel.ac.in/courses/106105173
3. http://www.cs.nthu.edu.tw/~jang/nfsc.htm

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SENSOR TECHNOLOGIES ON DRONES	
CSE-OE4(C)	**Credits: 3**
Instruction:3 Periods/Week	**Sessional Marks : 40**
End Exam : 3 Hours	**End Exam Marks : 60**

Prerequisites:

- Micro Processor and Micro Controller programming, Fundamentals of IoT and Robotics

Course Objectives:

- The main objective of this course is to understand the basics of Unmanned Arial Vehicles (Drones) and its connected sensor through various applications.
- The course imparts the working principle of the drone and explains the components that are used to build the drone devices.
- It provides the basic functionality of drones, design, fabrication, programming and flying and operation of UAV category aircraft. Also to understand the safety and regulations of UAV including maintenance.
- At the end of the course student would able to build a simple commercial applications with different sensor technologies

Course Outcomes:

By the end of the course, the student will be able to:	
1	Describe drone concepts, terminology and vocabulary;
2	Describe the development of unmanned aircraft systems (UAS) and design and fabrication of Drones
3	Apply Drone programming and Drone flying operations
4	Explain and apply of different drone accessories including sensor and maintenance, backup battery.
5	Apply safety measurements and regulations for commercial applications

Mapping of Course Outcomes with Program Outcomes:

Mapping		**PO**												**PSO**	
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO	**1**	3	-	1	3	-	-	-	-	-	-	-	-	1	1
	2	3	2	1	2	1	-	-	1	-	-	1	-	2	-
	3	2	3	3	-	1	-	-	1	-	-	1	-	2	-
	4	2	1	1	-	-	-	-	1	-	-	-	-	-	2
	5	2	3	2	-	-	-	-		-	-	-	-	1	2

SYLLABUS

UNIT I: INTRODUCTION TO DRONE TECHNOLOGY 12 Hours

Introduction - Basics of Flights, Different types of flight vehicles, Components and functions of an airplane, Forces acting on Airplane, Physical properties and structure of the atmosphere, UAV (Unmanned Aerial Vehicle- Drone), Definition, History of UAV , Characteristics of UAV, Applications of UAV (Defence, Civil, Environmental monitoring), Difference between Aircraft and UAV

Learning Outcome: At the end of this Unit the students will be able to

1. Acquiring basic skills in exploring the potential of the drone technology in professional activities;
2. Theoretical and practical knowledge required to design, build, program and use of the drones under safety conditions and according with the legislation in force.

UNIT II: (COMPONENTS OF DRONES) - DRONE DESIGN AND FABRICATION 12 Hours

Types of Drones, Components of a Drone, Frames: Lightweight and sold material, Working principles of Electromagnetic Motors, Types of Motors (Brushed DC motor, Brushless DC motor, Induction Motor), Microcontroller/microprocessor (Arducopter Flight Controller), Working principles of Electromagnetic radiations, Radio Transmitter and Receiver, Li-ion Battery, Electric Speed Controller, Global Positioning System, Camera

Learning Outcome: At the end of this Unit the students will be able to

1. Design, build and fly a simple rotor using basic materials that drops the slowest from a height of ten feet.
2. Explain the acquainted with the droning technology currently used and at the same time acquire and develop high-quality skills and competences, including entrepreneurial and digital competencies

UNIT III: DRONE PROGRAMMING, PAYLOAD FOR UAV 12 Hours

Drones configurations, The methods of programming, Payloads, Classification of Payloads, camera, sensors, radars, various measuring devices, classification of payload based on applications, Hyper spectral sensors, laser detection and range, synthetic aperture radar, thermal cameras, ultra sonic detectors, case study on payloads.

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Learning Outcome: At the end of this Unit the students will be able to

1. Apply in designing and manufacturing the drones, programming, operating, maintaining and using them safely.
2. Explain payload-based classification and compares the results obtained through a "lightweight" traffic classification approach

UNIT IV DRONE ACCESSORIES AND MAINTENANCE 12 Hours

Sensors, Onboard storage capacity, Removable storage devices, linked mobile devices and applications Method of drone inspection, charging the battery, cleaning the drone Storage Maintenance, resources and standards

Learning Outcome: At the end of this Unit the students will be able to

1. Discuss to Identify & select different types of drones, drone rules and regulations, drone applications, and important safety precautions
2. Explain different type of batteries, battery specifications and their charging techniques used in drone.

UNIT V SAFETY, REGULATIONS AND LAUNCH AND RECOVERY: 12 Hours

Launching systems, UAV Launch Methods for Fixed-Wing Vehicles, Vertical Take-off and Landing UAV Launch, Automatic Recovery systems. Regulatory and regulations: Civil Aviation Requirements, DGCA RPAS Guidance Manual, UAS Rules 2021.

UAV Navigation and Guidance System: Navigation, Dead Reckoning, Inertial, Radio Navigation, Satellite, Way point Navigation. Dijkstra's Algorithm, A- star Algorithm, UAV Guidance, Types of guidance, UAV communication systems, Ground control station, Telemetry, UAS future.

Learning Outcome: At the end of this Unit the students will be able to

1. Develop in finding technical applicable solutions to the design and development of UAS subsystems and payload modules
2. Design and develop to the development in research and industrial UAS projects

Text Books:

1. Mohammad H. Sadraey, Unmanned Aircraft Design A Review of Fundamentals, MORGAN & CLAYPOOL PUBLISHERS, 2017
2. Reg Austin, Unmanned Aircraft Systems : UAVs Design Development and Deployment,
3. Jung-Sup Um , Drones as Cyber-Physical Systems Concepts and Applications for the Fourth Industrial Revolution, Springer, 2019

Reference Books:

1. Andrew J. Keane and James P. Scanlan, Small Unmanned Fixed-wing Aircraft Design: A Practical Approach,
2. Gianluca Casagrande, András Sik, Gergely Szabó Small Flying Drones - Applications for Geographic Observation, Springer 2018
3. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010 4
4. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011
5. Andey Lennon "Basics of R/C model Aircraft design" Model airplane news publication.
6. Theory, Design, and Applications of Unmanned Aerial Vehicles.

ONLINE WEB RESOURCES:

1. https://dgt.gov.in/sites/default/files/DRONE%20_TECHNICIAN%20_NSQF%20_LEVEL_4.pdf
2. https://dgt.gov.in/sites/default/files/CTSRPA-DronePilot_CTS_NSQF-4.pdf
3. https://c2pipeline.wayne.edu/indicator-1-4/drones_activities_directions.pdf
4. https://tryengineering.org/teacher/designing-drones/
5. https://www.edudrone-project.eu/wp-content/uploads/2018/03/Drone-Technology-Curricula_EN.pdf

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