GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.COMPUTER SCIENCE AND ENGINEERING

2018 A REGULATIONS : VERTICALS CURRICULA AND SYLLABI

Vertical I **Artificial Intelligence**	**Vertical II** **Full Stack Development**	**Vertical III** **Data Science and Analytics**	**Vertical IV** **Cyber Security**
18SPE$19 - Knowledge Representation	18SPE$25 - Web Application Security (Common to CSE & IT)	18SPE$12 - Big Data Analytics	18SPE$33 - Modern Cryptography (Common to CSE & IT)
18SPE$20 - Ethics and AI (Common to CSE & IT)	18SPE$26 - Dev-ops (Common to CSE & IT)	18SPE$17 - Data Warehousing and Data Mining	18SPE$34 - Network Security
18SPE$21 - Deep Learning	18SPE$01- Introduction to Web Technology	18SPE$08 - Computer Vision	18SPE$35 - Security and Privacy in cloud (Common to CSE & IT)
18SPE$05 - Natural Language Processing	18SPE$07 - Cloud Engineering	18SPE$21 - Deep Learning	18SPE$36 - Crypto-currency and Blockchain Technologies (Common to CSE & IT)
18SPE$22 - Game Theory (Common to CSE & IT)	18SPE$27 - Principles of Programming Languages (Common to CSE & IT)	18SPE$30 - Recommender Systems (Common to CSE & IT)	18SPE$37 - Ethical Hacking (Common to CSE & IT)
18SPE$23 - Soft Computing	18SPE$28 - UI & UX design (Common to CSE & IT)	18SPE$31 - Exploratory Data Analytics (Common to CSE & IT)	18SPE$38 - Digital and Mobile Forensics (Common to CSE & IT)
18SPE$24 – Cognitive Science (Common to CSE & IT)	18SPE$29 – App Development (Common to CSE & IT)	18SPE$32 – Video Analytics (Common to CSE & IT)	18SPE$39 – Social Network Security (Common to CSE & IT)

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013
B.E.COMPUTER SCIENCE AND ENGINEERING
CBCS 2018 A REGULATIONS

Verticals – I

ARTIFICIAL INTELLIGENCE

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPE$19	Knowledge Representation	PE	40	60	100	3	0	0	3
2	18SPE$20	Ethics and AI (Common to CSE & IT)	PE	40	60	100	3	0	0	3
3	18SPE$21	Deep Learning	PE	40	60	100	3	0	0	3
4	18SPE$05	Natural Language Processing	PE	40	60	100	3	0	0	3
5	18SPE$22	Game Theory (Common to CSE & IT)	PE	40	60	100	3	0	0	3
6	18SPE$23	Soft Computing	PE	40	60	100	3	0	0	3
7	18SPE$24	Cognitive Science (Common to CSE & IT)	PE	40	60	100	3	0	0	3

Verticals – II

FULL STACK DEVELOPMENT

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPE$25	Web Application Security (Common to CSE & IT)	PE	40	60	100	3	0	0	3
2	18SPE$26	Dev-ops (Common to CSE & IT)	PE	40	60	100	3	0	0	3
3	18SPE$01	Introduction to Web Technology	PE	40	60	100	3	0	0	3
4	18SPE$07	Cloud Engineering	PE	40	60	100	3	0	0	3
5	18SPE$27	Principles of Programming Languages (Common to CSE & IT)	PE	40	60	100	3	0	0	3
6	18SPE$28	UI & UX design (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18SPE$29	App Development (Common to CSE & IT)	PE	40	60	100	3	0	0	3

Verticals – III

DATA SCIENCE AND ANALYTICS

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPE$12	Big Data Analytics	PE	40	60	100	3	0	0	3
2	18SPE$17	Data Warehousing and Data Mining	PE	40	60	100	3	0	0	3
3	18SPE$08	Computer Vision	PE	40	60	100	3	0	0	3
4	18SPE$21	Deep Learning	PE	40	60	100	3	0	0	3
5	18SPE$30	Recommender Systems (Common to CSE & IT)	PE	40	60	100	3	0	0	3
6	18SPE$31	Exploratory Data Analytics (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18SPE$32	Video Analytics (Common to CSE & IT)	PE	40	60	100	3	0	0	3

Verticals – IV

CYBER SECURITY

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	18SPE$33	Modern Cryptography (Common to CSE & IT)	PE	40	60	100	3	0	0	3
2	18SPE$34	Network Security	PE	40	60	100	3	0	0	3
3	18SPE$35	Security and Privacy in cloud (Common to CSE & IT)	PE	40	60	100	3	0	0	3
4	18SPE$36	Crypto-currency and Blockchain Technologies (Common to CSE & IT)	PE	40	60	100	3	0	0	3
5	18SPE$37	Ethical Hacking (Common to CSE & IT)	PE	40	60	100	3	0	0	3
6	18SPE$38	Digital and Mobile Forensics (Common to CSE & IT)	PE	40	60	100	3	0	0	3
7	18SPE$39	Social Network Security (Common to CSE & IT)	PE	40	60	100	3	0	0	3

VERTICALS – I

ARTIFICIAL INTELLIGENCE

18SPE$19	KNOWLEDGE REPRESENTATION

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.Basic of knowledge representation and classical logic 2.Representation of knowledge in propositional and predicate logics 3. Representation of inheritable knowledge 4. Representation of Non Monotonic Logic 5. Knowledge representation for simple application	
UNIT – I	**INTRODUCTION TO KNOWLEDGE REPRESENTATION**	**(9 Periods)**
Knowledge representation and classical logic - syntax, semantics and natural deduction - automated theorem proving - suitability of logic for knowledge representation - satisfiability solvers - SAT solver technology—complete methods - incomplete methods -beyond SAT: quantified Boolean formulas and model counting –approaches to knowledge representation –issues in knowledge representation.		
UNIT – II	**PROPOSITIONAL AND PREDICATE LOGIC**	**(9 Periods)**
Propositional logic - syntax and semantics -natural deduction - direct proofs - tableau method - first order logic - syntax and semantics - resolution refutation - unification algorithm - horn clauses and logic programming - PROLOG		
UNIT – III	**REPRESENTATION OF INHERITABLE KNOWLEDGE**	**(9 Periods)**
Semantic nets – frames – conceptual dependency –scripts –CYC – description logic and its extensions - DLs and predicate logic - tableau based reasoning techniques - other reasoning technique - DLs in ontology language applications –language independent representation		
UNIT – IV	**NON MONOTONIC LOGIC**	**(9 Periods)**
Non monotonic logic – types - default logic – auto epistemic logic - circumscription –preliminaries - computational properties - non monotonic inference relations - semantic specification of inference relations - relating default and auto epistemic logics - relating default logic and circumscription – other non-monotonic logics		
UNIT – V	**KNOWLEDGE REPRESENTATION IN APPLICATIONS**	**(9 Periods)**
Ontological engineering – categories and objects - events - mental events and mental objects – reasoning systems for categories – reasoning with default information- internet shopping world- knowledge representation and question answering - the semantic web: webizing knowledge representation		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Frank van Harmelen, Vladimir Lifschitz, Bruce Porter* ***"Handbook of Knowledge Representation"*** *,1st edition , ELSEVIER , 2007*
2	*Elaine Rich,Kevin Knight,Shivashankar B. Nair,* ***"Artificial Intelligence"****, 3rd edition, Tata McGraw Hill, 2009*

REFERENCES :

1	*Russell and Norvig,* ***"Artificial Intelligence, A Modern Approach"****, 3rd edition, Pearson Prentice Hall,2010*
2	*Ronald J. Brachman, Hector J. Levesque,* ***"Knowledge Representation and Reasoning"****, Morgan Kaufmann, 2004*
3	*Deepak Khemani.* ***"A First Course in Artificial Intelligence"****, McGraw Hill Education" 2013.*
4	*NPTEL Course:* ***"Artificial Intelligence: Knowledge Representation And Reasoning"*** *https://onlinecourses.nptel.ac.in/noc23_cs09/course*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Articulate the basics of knowledge representation and their methodology **(Familiarity)**
CO2	Apply propositional and predicate logic to represent knowledge required to explain the given scenario and create knowledge required base using PROLOG **(Usage)**
CO3	Use semantic nets, frames, conceptual dependency, scripts , CYC to express inheritable knowledge and description logic **(Usage)**
CO4	Identify the required non monotonic logic for the given scenario **(Usage)**
CO5	Identify suitable knowledge representation and create a knowledge base for simple applications**. (Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	L	M	M	M	L							M	L	L	L	L
CO2	L	M	M	M	L							M	L	L	L	L
CO3	L	H	H	H	L							M	L	L	L	M
CO4	L	H	H	L	L							L	L	L	L	L
CO5	L	L	H	L	H							L	L	L	L	H
18SPE$19	L	M	H	M	L							M	L	L	L	M
L –Low, M- Medium, H- High																

18SPE$20	**ETHICS AND AI** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Understand the need for ensuring ethics in Artificial Intelligence 2. Understand AI governance by human rights and other fundamental values. 3. Issues with accountability of AI systems 4. Technology driven perspectives to integrate ethics and economic values. 5. Futuristic applications	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Role of Artificial Intelligence in human life – Understanding Ethics – Need for Ethics in Artificial Intelligence – Ethical considerations of AI – Current initiatives of Ethics in AI – Ethical issues and artificial entities.		
UNIT – II	**FRAMEWORKS AND MODELS**	**(9 Periods)**
AI Governance by human rights – Incompatible initiatives of private sector AI – Normative Models – Codes and Standards – The role of professional norms in the governance of Artificial Intelligence.		
UNIT – III	**CONCEPTS AND ISSUES**	**(9 Periods)**
Accountability in Computing Systems – Transparency – Responsibility an AI – Ethical analysis and design – Race and Gender- AI as a moral right holder – autonomy.		
UNIT – IV	**PERSPECTIVES AND APPROACHES**	**(9 Periods)**
Social failure modes of technology and the Ethics of AI – A human centered approach for AI Ethics – Integrating Ethical values and economical values - Fairness – The complexity of otherness – Calculative composition		
UNIT – V	**CASES AND APPLICATIONS**	**(9 Periods)**
Ethics of AI in Transport – The case for Ethical AI in Military – Ethics of AI in Biomedical research, patient care and public health- Ethics of AI in Law – Robot teaching: pedagogy and policy – Smart City Ethics.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Markus D Dubber, Frank Pasquale, Sunil Das,* ***"The Oxford Handbook of Ethics of AI"****, Oxford University Press, 2020.*
2	*Paula Beddington,* ***"Towards a Code of Ethics for Artificial Intelligence"****, Springer, 2017.*

REFERENCES :

1	*S. Matthew Liao,* ***"Ethics of Artificial Intelligence"****, Oxford University Press, 2020.*
2	***Nick Bostrom and Eliezer Yudkowsky, "The Ethics of Artificial Intelligence", Cambrige University Press, 2014.***
3	*Wallach W and Allen C,* ***"Moral Machines: Ceaching Robots Right From Wrong",*** *Oxford Univeristy Press, 2008*
4	*Mark Coeckelbergh,* ***"AI Ethics",*** *MIT Press, 2020.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Identify the need for Ethics in Artificial Intelligence **(Familiarity)**
CO2	Summarize frameworks for normative assessment and governance **(Familiarity)**
CO3	Describe the ethical dimensions of Artificial Intelligence **(Familiarity)**
CO4	Criticize selection of methodological approached for AI Ethics **(Familiarity)**
CO5	Argue Ethics in AI for selected Artificial Intelligence applications **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1						H		H				M			M	L
CO2						H		H				M			M	M
CO3						H		H				M			M	M
CO4						H		H				M			M	M
CO5						H		H				M			M	M
18SPE$20						H		H				M			M	M
L –Low, M- Medium, H- High																

18SPE$21	DEEP LEARNING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Emphasizing knowledge on various deep learning algorithms.	
UNIT – I	**INTRODUCTION TO DEEP LEARNING**	**(9 Periods)**
Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.		
UNIT – II	**FEEDFORWARD NETWORKS**	**(9 Periods)**
Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders.		
UNIT – III	**DEEP NEURAL NETWORKS**	**(9 Periods)**
Difficulty of training deep neural networks, Greedy layerwise training. Gradient Descent (GD), Stochastic Gradient Descent (GD), Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), Regularization methods (dropout, drop connect, batch normalization).		
UNIT – IV	**CONVOLUTIONAL NEURAL NETWORKS**	**(9 Periods)**
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet		
UNIT – V	**RECURRENT NEURAL NETWORKS**	**(9 Periods)**
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Ian Goodfellow and Yoshua Bengio and Aaron Courville., **" Deep Learning ",** MIT Press, 2016*

REFERENCES :

1	*Raúl Rojas, **" Neural Networks: A Systematic Introduction ",** Springer-Verlag, Berlin,1996.*
2	*Yegnanarayana, B., **" Artificial Neural Networks ",** PHI Learning Pvt. Ltd, 2009*
3	*Christopher Bishop., **" Pattern Recognition and Machine Learning ",** Springer,2016*
4	*Nikhil Buduma, **"Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms",** O'Reilly publications, 2017*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Summarize the basics of neural network and deep learning **(Familiarity)**
CO2	Implement basic neural network model with hidden layers **(Usage)**
CO3	Analyze optimization and generalization in deep learning **(Assessment)**
CO4	Criticize convolutional neural network and how it is applied to analyzing visual imagery **(Assessment)**
CO5	Appraise Recurrent Neural Network (RNN) and its temporal dynamic behavior which helps us to remembers some information about a sequence to predict the next information **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	L	M	L		L						L	H	L	L	M
CO2	H	H	H	M	H	L						L	H	M	M	M
CO3	H	H	H	H	H	L						L	H	L	M	L
CO4	H	H	H	H	H	L						L	H	L	M	M
CO5	H	H	H	H	H	L						L	H	L	M	M
18SPE$21	H	H	H	H	H	L						L	H	L	M	M
L –Low, M- Medium, H- High																

18SPE$05	NATURAL LANGUAGE PROCESSING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: To learn the fundamentals of natural language processing To understand the use of CFG and PCFG in NLP To understand the role of semantics of sentences and pragmatics To apply the NLP techniques to IR applications	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance		
UNIT – II	**WORD LEVEL ANALYSIS**	**(9 Periods)**
Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.		
UNIT – III	**SYNTACTIC ANALYSIS**	**(9 Periods)**
Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures.		
UNIT – IV	**SEMANTICS AND PRAGMATICS**	**(9 Periods)**
Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.		
UNIT – V	**DISCOURSE ANALYSIS AND LEXICAL RESOURCES**	**(9 Periods)**
Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).		
Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods		

TEXT BOOKS :

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

REFERENCES :

1	*Breck Baldwin,* ***"Language Processing with Java and LingPipe Cookbook",*** *Atlantic Publisher, 2015.*
2	Richard M Reese, **"Natural Language Processing with Java",** OReilly Media, 2015.
3	*Nitin Indurkhya and Fred J. Damerau,* ***"Handbook of Natural Language Processing",*** *Second Edition, Chapman and Hall/CRC Press, 2010.*
4	*Tanveer Siddiqui, U.S. Tiwary,* ***"Natural Language Processing and Information Retrieval",*** *Oxford University Press, 2008.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	To tag a given text with basic Language features **(Familiarity)**
CO2	To design an innovative application using NLP components **(Familiarity)**
CO3	To implement a rule based system to tackle morphology/syntax of a language **(Familiarity)**
CO4	To design a tag set to be used for statistical processing for real-time applications **(Familiarity)**
CO5	To compare and contrast the use of different statistical approaches for different types of NLP applications **(Familiarity)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	M	L	L	L	L							M		L	L
CO2	M	M	H	H	M	L						M	M	H	M	M
CO3	M	M	H	H	M	L						M	M	H	M	M
CO4	M	M	H	H	M	L						M	M	H	M	M
CO5	M	H	M	H	M	L						M	M	H	M	M
18SOE$05	M	M	H	H	M	L						M	M	H	M	M
L –Low, M- Medium, H- High																

18SPE$22	**GAME THEORY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To understand the fundamentals of game theory. 2. To formalize the notion of strategic thinking and rational choice by using the tools of game theory, and to provide insights into using game theory in modeling applications 3. To draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues. 4. To introduce contemporary topics in the intersection of game theory, computer science, and economics. 5. To apply game theory in Coalitional games.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Introduction: What is Game Theory - An outline of the history of game theory- Definition of Games- Actions, Strategies, Preferences, Payoffs – Examples - Strategic form games and examples: Prisoner's Dilemma, Bach or Stravinsky, Matching Pennies - Notion of Nash Equilibrium - Examples of Nash Equilibrium - Best Response Functions - Dominated Actions - Symmetric Games and Symmetric Equilibria.		
UNIT – II	**GAMES WITH PERFECT INFORMATION**	**(9 Periods)**
Mixed Strategy Nash Equilibrium- Randomization of Actions, Mixed strategy Nash equilibrium, Dominated actions, Pure strategy equilibria in the presence of randomization, Illustrations: expert diagnosis reporting a crime - Finding all mixed strategy Nash equilibria of some representative games.		
UNIT – III	**EXTENSIVE GAMES WITH PERFECT INFORMATION**	**(9 Periods)**
Extensive games with Perfect Information- Extensive games, Strategies and outcomes, Nash equilibrium, Subgame perfect equilibrium, finding subgame perfect equilibria using backward induction - Allowing for simultaneous moves in extensive games with perfect information - Example of committee decision making - Two Player Zerosum Games: Maxminimization and Nash Equilibrium - Strictly competitive games - Nash equilibrium in strictly competitive games - Minimax theorem - Solution via linear programming - Examples.		
UNIT – IV	**GAMES WITH IMPERFECT INFORMATION**	**(9 Periods)**
Bayesian and Repeated Games - Motivational Examples - Definition of a Bayesian Game and Bayesian Nash Equilibrium and examples - Auctions: Independent private values, Nash equilibrium of first price auction and second price auction, common valuations, revenue equivalence of auctions - Idea of repeated games - Finitely repeated prisoner's dilemma, infinitely repeated prisoner's dilemma, strategies in a repeated prisoner's dilemma, Nash equilibria and equilibria payoffs in infinitely repeated prisoner's dilemma, sub-game perfect equilibria and equilibria payoffs in infintely repeated prisoner's dilemma.		
UNIT – V	**COALITIONAL GAMES**	**(9 Periods)**
Coalitional Games - The Core - Illustrations: Ownership and distribution of wealth - exchanging homogeneous items - exchanging heterogeneous items - voting – matching - Shapley value and examples.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*M. J. Osborne,* ***"An Introduction to Game Theory"****, Oxford University Press, 2004.*

REFERENCES :

1	*M. Machler, E. Solan, S. Zamir,* ***"Game Theory"****, Cambridge University Press, 2013*
2	N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani (Editors), "Algorithmic Game Theory" Cambridge University Press, 2007.
3	*A.Dixit and S. Skeath,* ***"Games of Strategy"****, Second Edition, W W Norton & Co Inc, 2004.*
4	*YoavShoham, Kevin Leyton-Brown,* ***"Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations"****, Cambridge University Press 2008.*
5	*Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar and Hjorungnes,* ***"Game Theory in Wireless and Communication Networks"****, Cambridge University Press, 2012.*
6	*Y.Narahari,* ***"Game Theory and Mechanism Design"****, IISC Press, World Scientific.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Summarize the fundamentals of game theory and concepts. **(Familiarity)**
CO2	Discuss the use of Nash Equilibrium for other problems. **(Familiarity)**
CO3	Identify key strategic aspects and based on these be able to connect them to appropriate game theoretic concepts given a real world situation. **(Usage)**
CO4	Identify some applications that need aspects of Bayesian Games. **(Usage)**
CO5	Use various Coalitional games concepts. **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	L	M	L	M	M							M	M	M	L	L
CO2	L	M	L	M	M				L	M	L	M	M	M	L	L
CO3	L	M	M	M	H					M	M	L	M	M	M	M
CO4	L	M	M	M	H				L	M	M	L	M	M	M	M
CO5	L	M	M	M	H			L	M	M	M	M	M	M	M	M
18SPE$22	L	M	M	M	H			L	L	M	M	M	M	M	M	M
L –Low, M- Medium, H- High																

18SPE$23	SOFT COMPUTING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To study the fundamental concepts of soft computing techniques. 2. To explore fuzzy logic, genetic algorithm, multi-objective optimization problems 3. To explain the various architectures and algorithms of neural networks.	
UNIT – I	**INTRODUCTION TO SOFT COMPUTING**	**(9 Periods)**
Concept of computing systems - Soft computing versus hard computing - Characteristics of soft computing -Applications of soft computing techniques		
UNIT – II	**FUZZY LOGIC**	**(9 Periods)**
Introduction to Fuzzy logic -Fuzzy sets and membership functions -Operations on fuzzy sets - Fuzzy rlations, rules, propositions, implications and inferences - Defuzzification techniques -Fuzzy logic controller design -Applications of fuzzy logic		
UNIT – III	**ARTIFICIAL NEURAL NETWORKS**	**(9 Periods)**
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 – Neuro Fuzzy systems		
UNIT – IV	**GENETIC ALGORITHM**	**(9 Periods)**
Concept of genetics and evolution – Application to probabilistic search techniques – Basic GA framework – Different GA architectures – GA operators: encoding, crossover, selection , mutation – Solving single-objective optimization problems using GA		
UNIT – V	**MULTI-OBJECTIVE OPTIMIZATION**	**(9 Periods)**
Concept of Multi-objective Optimization problems – Issues in solving them – Multi-objective evolutionary algorithm – Non-Pareto approaches to solve MOOPs - Pareto approaches to solve MOOPs – Applications with multi-objective evolutionary algorithm		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Pratihar, D. K..,* ***"Soft Computing: Fundamentals and Applications."****, Narosa, 2015.*
2	*Kalyanmoy Deb,* ***"Multi-Objective Optimization Using Evolutionary Algorithms",*** *John Wiley & Sons, Ltd, 2008*

REFERENCES :

1	*George J. Klir and Bo Yuan,* ***"Fuzzy Sets and Fuzzy Logic-Theory and Applications",*** *Prentice Hall, 1995.*
2	*James A. Freeman and David M. Skapura,* ***"Neural Networks Algorithms, Applications, and Programming Techniques"****, Pearson Edn., 2003.*
3	*David E. Goldberg,* ***"Genetic Algorithms in Search, Optimization and Machine Learning",*** *Addison Wesley, 1997.*
4	*Simon Haykin,* ***"Neural Networks and Learning Machines",*** *Third Edition, Pearson Education, 2009.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Identify the essential components of soft computing. **(Familiarity)**
CO2	Apply fuzzy rules for decision making in real-time scenarios. **(Usage)**
CO3	Apply neural networks to real world applications. **(Usage)**
CO4	Investigate ideas behind search strategies using genetic algorithms and multi-objective optimization. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	M	M	L						M		M	H	M		L
CO2	H	M	M	L						M		M	H	M		L
CO3	H	M	M	L						M		M	H	M		L
CO4	H	M	M	L						M		M	H	M		L
18SPE$23	H	M	M	L						M		M	H	M		L
L –Low, M- Medium, H- High																

18SPE$24	COGNITIVE SCIENCE *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To know the theoretical background of cognition. 2. To understand the link between cognition and computational intelligence. 3. To explore probabilistic programming language. 4. To study the computational inference models of cognition. 5. To study the computational learning models of cognition.	
UNIT – I	**PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE**	**(9 Periods)**
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Detour before the naturalistic turn – The Philosophy of Science – The Mind in Cognitive Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing – Neurosciences: Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.		
UNIT – II	**COMPUTATIONAL INTELLIGENCE**	**(9 Periods)**
Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making – Decision making under Uncertainty – Learning – Language – Vision – Robotics.		
UNIT – III	**PROBABILISTIC PROGRAMMING LANGUAGE**	**(9 Periods)**
WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations –Enumeration – Other basic computation.		
UNIT – IV	**IMPLEMENTING THE INFERENCE MODELS OF COGNITION**	**(9 Periods)**
Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.		
UNIT – V	**IMPLEMENTING THE LEARNING MODELS OF COGNITION**	**(9 Periods)**
Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's Razor – Learning (Deep) Continuous Functions – Mixture Models.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Robert A. Wilson, Frank C. Keil,* ***"The MIT Encyclopedia of the Cognitive Sciences"****, The MIT Press, 1999.*

REFERENCES :

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

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Understand the theory behind cognition. **(Familiarity)**
CO2	Connect to the cognition elements computationally. **(Usage)**
CO3	Implement mathematical functions through WebPPL. **(Usage)**
CO4	Develop a cognitive inference model. **(Usage)**
CO5	Develop a cognitive learning model. **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	M	H	L						L		L	H	M		
CO2	H	M	H	L						L		L	H	M	L	
CO3	H	M	H	L	H					L		L	H	M	L	
CO4	H	M	H	L						L		L	H	M	L	
CO5	H	M	H	L						L		L	H	M		
18SPE$24	H	M	H	L	M					L		L	H	M	L	
L –Low, M- Medium, H- High																

VERTICALS – II

FULL STACK DEVELOPMENT

18SPE$25	**WEB APPLICATION SECURITY** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To Equip students with common security threats faced by web applications, such as SQL injection, cross-site scripting (XSS), cross-site request forgery (CSRF), and man-in-the-middle attacks 2. To Respond effectively to security threats and incidents 3. To Design secure web applications from the ground up, including secure authentication and authorization, secure communication protocols, firewalls, intrusion detection systems 4. To Apply industry standards and regulations, such as OWASP Top 10, and PCI DSS, that outline best practices for web application security 5. To Understand the principles of web security, browser security and database security and prevent security vulnerabilities	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Structure of a Modern Web Application – REST APIs – Javascript – SPA Frameworks – Web Servers – Server side databases – Client-side data stores – Network Security vs Application Security – Thinking like a defender – OWASP Top Ten List – Security Fundamentals – Input Validation – Attack surface reduction – Classifying and Prioritizing threats		
UNIT – II	**WEB SECURITY PRINCIPLES**	**(9 Periods)**
Authentication – Two factor and Three factor authentication – Web application authentication – Securing Password based authentication – Best Practices – Authorization – Access Control – Session management fundamentals – Securing web application session management		
UNIT – III	**BROWSER SECURITY**	**(9 Periods)**
Same origin policy – Definition – Client side vs Server side - Exceptions – Cross site Scripting – XSS Discovery and Exploitation – Stored XSS – Reflected XSS – DOM-based XSS – Mutation-based XSS - Cross site Request Forgery – Query parameter tampering – Alternate GET payloads – CSRF against POST endpoints		
UNIT – IV	**DATABASE AND FILE SECURITY**	**(9 Periods)**
SQL Injection – Code injection – Command injection – Setting database permissions – Stored procedure security – Insecure direct object references – File Security principles – Keeping source code secure – Security through Obscurity – Forceful browsing – Directory traversal		
UNIT – V	**SECURE DEVELOPMENT AND DEPLOYMENT**	**(9 Periods)**
Securing modern web applications – Secure application architecture – Reviewing Code – Vulnerability discovery and management – Defending against XSS, CSRF, XXE, Injection and DoS attacks – Industry standards – Maturity models – Securing third party dependencies		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Andrew Hoffman,* ***"Web Application Security – Exploitation and Countermeasures for Modern Web Applications"****, O'Reilly, 2020.*
2	*Bryan Sullivan, Vincent Liu,* ***"Web Application Security – A Beginner's Guide"****, McGraw Hill, 2012.*

REFERENCES :

1	*Mike Shema,* ***"Hacking Web Apps – Detecting and Preventing Web Application Security Problems"****, Elsevier, 2012.*
2	*Ron Lepofsky,* ***"The Manager's Guide to Web Application Security – A Concise guide to Web Application Security"****, Apress, 2014.*
3	*Dafydd Stuttard, Marcus Pinto,* ***"The Web Application Hacker's Handbook – Finding and Exploiting Security flaws"****, John Wiley & Sons, Second Edition, 2011.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Be familiar with secure coding best practices, such as OWASP Top 10. **(Familiarity)**
CO2	Write secure code, including input validation, error handling, and password protection. **(Usage)**
CO3	Comprehend the most common web security threats, such as cross-site scripting (XSS), cross-site request forgery (CSRF), SQL injection, and others. **(Usage)**
CO4	Implement and manage web security policies and procedures, including incident response planning and management, security auditing, and security monitoring. **(Usage)**
CO5	Identify and prioritize potential security threats to web applications and develop effective strategies for mitigating those threats. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	M	H	L	M			H		L		L	H	M		M
CO2	H	M	H	L	M			H		L		L	H	M	L	H
CO3	H	M	H	L	M			H		L		L	H	M	L	H
CO4	H	M	H	L	M			H		L		L	H	M	L	M
CO5	H	M	H	L	M			H		L		L	H	M		M
18SPE$25	H	M	H	L	M			H		L		L	H	M	L	M
L –Low, M- Medium, H- High																

18SPE$26	**DEV-OPS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Understanding of DevOps principles, including continuous integration (CI), continuous delivery (CD), and agile development methodologies 2. Familiar with a range of DevOps tools and technologies, such as Git, Jenkins, Docker, Kubernetes, and Ansible 3. Manage and Orchestrate containers using Docker and Kubernetes 4. Write scripts to automate tasks and create pipelines for CI/CD 5. Understand Monitoring and Logging tools, such as Prometheus and Grafana, and the ability to use them to monitor and analyze system performance	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
What is DevOps – Roles and responsibilities of DevOps engineer – DevOps and SDLC – Virtualization – Shell scripting – SSH – Git for DevOps – Branches – Merge requests – Commits – Resolving Conflicts – Deletions – Build tools and Package managers – Artifact Repository manager		
UNIT – II	**CONTAINERS**	**(9 Periods)**
What is container – Docker components and architecture – Docker vs. Virtual machine – Main docker commands – Docker compose – running multiple services – Dockerfile – Building a docker image - Deploy containerized app – Docker volumes		
UNIT – III	**ORCHESTRATION**	**(9 Periods)**
What is Container orchestration - Introduction to Kubernetes – Components – Architecture – Commands – YAML configuration – Namespaces – Service types – Persisting data – Deploying Kubernetes Cluster – Stateful app deployment using Helm		
UNIT – IV	**CI/CD PIPELINE**	**(9 Periods)**
What is Build Automation – Continuous Integration and Continuous Delivery Principles - Introduction to Jenkins – Install Jenkins on Cloud Server – Plugins – Build tools – Docker in Jenkins – Configuring Jenkins pipeline – Multi-branch pipeline Job - Webhooks		
UNIT – V	**MONITORING**	**(9 Periods)**
Docker container monitoring – statistics – metrics – events – Performance monitoring – Container monitoring – Container administration – Auditing and Analyzing Vulnerabilities in Kubernetes – Enhancing observability and monitoring in Kubernetes with Prometheus and Grafana		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Mikael Krief,* ***"Learning DevOps - The complete guide to accelerate collaboration with Jenkins, Kubernetes, Terraform and Azure DevOps"****, Packt Publishing, 2019*
2	*Jose Manuel Ortega Candel,* ***"Implementing DevSecOps with Docker and Kubernetes"****, BPB Publications, First Edition, 2022*

REFERENCES :

1	*Joakim Verona,* ***"Practical DevOps"****, Packt Publishing, 2016*
2	*Len Brass, Ingo Weber, Liming Zhu,* ***"DevOps – A Software Architect's Perspective"****, Pearson Education, 2015*
3	*Gene Kim, Jez Humble, Patrick Debois, John Willis,* ***"The DevOps Handbook – How to create world-class agility, reliability and security in technology organizations"****, IT Revolution, Second edition, 2016*
4	*Jennifer Davis, Katherine Daniels,* ***"Effective DevOps"****, O'Reilley Media, 2015*
5	*https://github.com/milanm/DevOps-Roadmap*
6	*https://github.com/annfelix/DEVOPS-WORLD*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Explore the DevOps principles and practices, such as continuous integration, continuous delivery, infrastructure as code, and collaboration between development and operations teams. **(Familiarity)**
CO2	Implement containerization and container orchestration using tools such as Docker and Kubernetes. **(Usage)**
CO3	Create and manage infrastructure on public and private cloud platforms such as AWS, Azure, and GCP using tools such as Terraform and CloudFormation. **(Assessment)**
CO4	Write scripts to automate tasks and create pipelines for continuous integration and continuous delivery. **(Usage)**
CO5	Extrapolate the purpose of monitoring and logging tools such as Prometheus and Grafana and be able to use them to monitor and analyze system performance. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	H	H	M	M	M	H	L		M	M	H	M	M	L	M
CO2	M	H	H	H	H	H	H	L	M	M	M	H	M	M	L	L
CO3	M	H	H	H	H	H	H	L	M	M	M	H	M	M	L	L
CO4	M	H	H	H	H	H	H	L	M	M	M	M	M	M	M	M
CO5	M	H	H	H	H	H	H	L	M	M	M	H	M	M	M	L
18SPE$26	M	H	H	H	H	H	H	L	M	M	M	H	M	M	L	L
L –Low, M- Medium, H- High																

18SPE$01	INTRODUCTION TO WEB TECHNOLOGY

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: Hyper Text Markup Language Cascading Style Sheets Client side scripting with Java script XML and Ajax enabled Internet application design Server side Development	
UNIT – I	INTRODUCTION TO HTML AND CSS	(9 Periods)
Introduction to computers and Internet – HTML: Basic HTML Elements, Input and page structure Elements- Cascading Style Sheet: Inline and embedded Styles, Positioning elements, Backgrounds, Element Dimensions, Box Model and Text Flow, Media Types and queries, Shadows, Gradients, Animations, Transitions and Transformations, Web Font, Multi column Layout.		
UNIT – II	CLIENT SIDE SCRIPTING	**(9 Periods)**
Java script: Programming Basics- Introduction to Scripting, Control Statement, Functions, Arrays, Objects: Math, String, Date, Boolean, document Objects, Document Object Model, Event Handling.		
UNIT – III	XML and AJAX ENABLED RICH INTERNET APPLICATIONS	**(9 Periods)**
XML: Basics, Structuring Data, XML Name spaces, DTDs-Schema Documents, Extensible style sheet Language and XSL Transformation, DOM – Web application Development: Traditional Vs Ajax web application Development, RIA with Ajax, XML Http Request Object, Using XML and DOM, Application creation.		
UNIT – IV	SERVER SIDE DEVELOPMENT	**(9 Periods)**
Web Servers: HTTP Transactions, Multi tier Application Architecture, Accessing Web Servers, Apache, MySQL and PHP Installation, IIS Express and Web Matrix-Database: MySQL- PHP: Data Types, Operators, Arrays, String Processing, Form Processing and Business Logic, Reading from a Database, Cookies, Dynamic Content.		
UNIT – V	SERVER-SIDE DEVELOPMENT WITH JSF AND JAVA	**(9 Periods)**
Java Server Faces: Application Development, Model View Controller Architecture, JSF Components, Validation, Session Tracking, Accessing Databases in Web Apps, Web Services: SOAP, REST, JSON, Publishing and Consuming SOAP based web services, REST based XML Web services, REST Based JSON Web Service.		
Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods		

TEXT BOOKS :

1	Paul Deitel, Harvey Deitel, Abbey Deitel “Internet and World Wide Web- How to Program” Fifth Edition, Pearson,2012.

REFERENCES :

1	Achyut Godbole, Atul Kahate, "Web Technologies:TCP/IP to Internet Application Architectures", Tata McGraw-Hill Education, 2002.
2	Nicholas C. Zakas, "Professional Javascript for Web Developers", Third Edition, Wrox Press,2011.
3	Jon Duckett, "Beginning Web Programming with HTML, XHTML and CSS", Wrox Press, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Design a web page with HTML elements and CSS. [Usage]
CO2	Write client side scripts using Javascript. [Usage]
CO3	Structure Data using XML. [Usage]
CO4	Create and access the web servers. [Usage]
CO5	Develop applications using JSF and Java [Usage]

COURSE ARTICULATION MATRIX:

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	H	M			M		L	L	H	H	H	H	H
CO2	H	H	H	H	H			M		L	L	H	H	H	H	H
CO3	H	H	H	H	H			M		L	L	H	H	H	H	H
CO4	H	H	H	H	H			M		L	L	H	H	H	H	H
CO5	H	H	H	H	H			M		L	L	H	H	H	H	H
18SPE$01	H	H	H	H	H			M		L	L	H	H	H	H	H
L –Low, M- Medium, H- High																

18SPE$07	CLOUD ENGINEERING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: Cloud Architecture Cloud Services Web Based Cloud Computing Cloud Security	
UNIT – I	INTRODUCTION	**(9 Periods)**
Introduction – Cloud types – Characteristics - Assessing the Value Proposition -Cloud Computing Stack - Connecting to the Cloud -Infrastructure as a Service (IaaS) -Platform as a Service (PaaS) -Software as a Service (SaaS) -Identity as a Service (IDaaS)- Compliance as a Service (CaaS).		
UNIT – II	VIRTUALIZATION	**(9 Periods)**
Basics of virtualization – Types of Virtualization – Implementation Levels of Virtualization –Virtualization Structures – tools and Mechanisms – Virtualization of CPU, Memory, I/O Devices –Virtual clusters and resource management – Virtualization for data –center Automation.		
UNIT – III	CLOUD INFRASTRUCTURE	**(9 Periods)**
Architectural Design of Compute and Storage clouds – Layered Cloud Architecture Development – Design Challenges – Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.		
UNIT – IV	CLOUD APPLICATION PROGRAMMING AND THE ANEKA PLATFORM	**(9 Periods)**
Aneka - Framework overview - anatomy of the Aneka container - Cloud programming and management - Programming applications with threads - Multithreading with Aneka – Task computing - Task-based application models - Aneka task-based programming - Data-Intensive Computing - Aneka MapReduce programming.		
UNIT – V	SECURITY IN THE CLOUD	**(9 Periods)**
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service security –Security Governance – Risk Management – Security Monitoring – Security Architecture Design –Data Security – Application Security – Virtual Machine Security- Identity Management and Access Control – Autonomic Security.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	Sosinsky, Barrie. "Cloud computing bible", Vol. 762. John Wiley & Sons, 2010.
2	Kai Hwang, Geoffrey C. Fox, Jack, J. Dongarra "Distributed and Cloud Computing from Parallel Processing to the Internet of Things", Elsevier 2012.
3	Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi "Mastering Cloud Computing Foundations and Applications Programming", 2013.
4	John W. Rittinghouse, James F. Ransome, "Cloud Computing Implementation, Management, and Security", CRC Press, 2010.
5	Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security & Privacy" O'ReillyMedia, September 2009.

REFERENCES :

1	Haley Beard, "Cloud Computing Best Practices for Managing and Measuring Processes for on demand Computing, Applications and Data Centers in the Cloud with SLAS". Emereo Pvt Limited, July 2008.
2	John Ritting house & James Ransome, "Cloud Computing, Implementation, Management and Strategy", CRC Press, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Explain the cloud architecture and cloud storage [Familiarity]
CO2	Create Cloud computing applications [Usage]
CO3	Use Cloud services [Usage]
CO4	Explain web based cloud services and tools [Familiarity]
CO5	Explain the necessity and approaches for cloud security.[Familiarity]

COURSE ARTICULATION MATRIX:

COs/POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	H	H	M				M				H	H	M	H	H
CO2	H	H	H	M				M				H	H	M	H	H
CO3	H	H	H	M				M				H	H	M	H	H
CO4	H	H	H	M				M				H	H	M	H	H
CO5	H	H	H	M				M				H	H	M	H	H
18SOE$07	H	H	H	M				M				H	H	M	H	H
L –Low, M- Medium, H- High																

18SPE$27	PRINCIPLES OF PROGRAMMING LANGUAGES *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. Describe syntax and semantics of programming languages 2.Understand call-return architecture and ways of implementing them 3.Analyze and Evaluate the different programming paradigms 4. Practice Functional and Concurrent programming with Haskell 5. Explain the design concepts and issues behind programming languages like C, Java, Scala, Lisp, Prolog, or any new language.	
UNIT – I	**FOUNDATIONS**	**(9 Periods)**
Evolution of Major Programming Languages –Overview of Compilation – Describing Syntax and Semantics – Lexical and Syntax analysis - Names, Scopes and Bindings – Data Types – Expressions and Assignment Statements –Type Systems		
UNIT – II	**CORE ISSUES IN LANGUAGE DESIGN**	**(9 Periods)**
Control Flow – Structured and Unstructured Flow – Sequencing – Selection – Iteration – Recursion – Subroutines and Control Abstraction – Stack layout – Calling Sequences – Parameter Passing – Blocks – Dynamic Scoping - Exception Handling – Coroutines - Events		
UNIT – III	**OBJECT ORIENTED PARADIGM**	**(9 Periods)**
Abstract Data Types and Encapsulation Concepts – Design Issues – Namespaces - Inheritance - Inner Classes – Type Extensions – Dynamic Method Binding – Mix-in Inheritance – True Multiple Inheritance - Examples – Object Models – Smalltalk, C++, Java, Scala		
UNIT – IV	**FUNCTIONAL AND LOGIC PROGRAMMING**	**(9 Periods)**
Functional Programming – Programs as Functions – Delayed Evaluation – Lambda Calculus – Examples from Lisp - Introduction to Haskell Programming – Comparison of Functional and Imperative languages – Logic Programming - Predicate Calculus – Proving theorems – Resolution and Unification - Elements of Prolog – Applications		
UNIT – V	**CONCURRENT PROGRAMMING**	**(9 Periods)**
Parallel Processing and Programming Languages – Threads – Semaphores – Monitors – Message Passing – Parallelism in Non-Imperative Languages – Java threads – Haskell concurrency primitives and abstractions		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	Robert W. Sebesta, “Concepts of Programming Languages”, Pearson Education, Twelfth Edition, 2019
2	Michael L. Scott, “Programming Language Pragmatics”, Morgan Kauffman, Fourth Edition, 2016

REFERENCES :

1	Kenneth C. Louden, Kenneth A. Lambert, "Programming Languages – Principles and Practice", Course Technology, Cengage Learning, Third Edition, 2011
2	Daniel P. Friedman, Mitchell Wand, "Essentials of Programming Languages", MIT Press, Third Edition, 2008
3	Carlo Ghezzi, Mehdi Jazayeri, "Programming Language Concepts", John Wiley & Sons, Third Edition, 2008
4	Peter Sestoft, "Programming Language Concepts", Springer-Verlag, Second Edition, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Understand key concepts and theories behind programming languages, including syntax, semantics, grammar, and parsing. **(Familiarity)**
CO2	Compare the different programming language paradigms and be able to choose the appropriate paradigm for different types of software. **(Usage)**
CO3	Explain the core issues in procedural and object-oriented programming language design. **(Familiarity)**
CO4	Apply functional programming concepts and logic programming concepts and be able to write functional code using languages such as Lisp or Prolog or Haskell or Scheme. **(Usage)**
CO5	Describe the principles of concurrent and parallel programming, including threads, locks, and semaphores, and be able to write concurrent and parallel code using languages Java or Haskell. **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	L	L	M	L	M								M	M	M	M
CO2	M	M	M	L	M								M	M	H	M
CO3	M	L	M	L	M								M	M	H	M
CO4	M	L	L	L	H								M	M	H	M
CO5	M	M	L	L	H								M	M	H	M
18SPE$27	M	L	M	L	M								M	M	H	M
L –Low, M- Medium, H- High																

18SPE$28	UI AND UX DESIGN *(Common to CSE &IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.Principles of UX design, such as user research, user personas and user journey mapping 2.Importance of color theory, typography, layout, and visual hierarchy 3.Usage of design tools and software, such as Sketch, Figma, Adobe XD and Invision 4.Usage of wireframes and prototypes using design software to communicate design ideas 5.Methods for evaluating user interfaces	
UNIT – I	**INTRODUCTION TO UI DESIGN**	**(9 Periods)**
Basics of HCI - Design process- HCI in software process – Basics of interaction design - UI Design and Why it matters – UI disasters – Case studies – Design Process – Introduction – Usability Engineering – Task centered approaches – Use cases – Personas – Tasks – Scenarios –Design centered approaches – Psychology and human factors for UI Design – Fitts Law – Short-term – long-term – attention – perception – conceptual models – Design principles – visibility – feedback – mappings – constraints – High-level models – distributed cognition – activity theory – situated action		
UNIT – II	**USER RESEARCH**	**(9 Periods)**
UserCentered Approaches to Interaction Design -User Research methods – Interview and Focus groups – Observations – Contextual inquiry – Ethics and Consent – User Research Protocol – Log Analysis – Surveys and Questionnaires – Translating User Research to Support design – Qualitative analysis – Quantitative analysis – Examples - Implications for Design – From Research to Ideas – Ideation – Selection – Communicating to Stakeholders		
UNIT – III	**PROTOTYPING**	**(9 Periods)**
Interface Prototying techniques – Low fidelity – Paper prototype – Wireframing – Tool-based – Physical low fidelity prototyping – Introduction to Design principles and patterns – Layout – Color and consistency – Cultural factors – Interaction design patterns – Google Material design – Design critiques – eliciting and giving feedback		
UNIT – IV	**UNIVERSAL DESIGN**	**(9 Periods)**
Introduction – Sensory and Cognitive Impairments – Physical limitations – tools and standards – Design for older adults and children – Socio-economic differences – Design for different platforms and contexts – Mobile UI design – Wearable – Automotive User Interfaces – IoT and Physical Computing		
UNIT – V	**EVALUATING USER INTERFACES AND TOOLS**	**(9 Periods)**
Introduction to Evaluating User interfaces and Evaluation in UI Design process – Evaluation without users – Action Analysis – Cognitive Walkthroughs – Heuristic Evaluation – Nielsen's heuristics – Evaluation with Users – User Testing – Goals – Formative and Summative Evaluation – Ethics in evaluation – Tools – Adobe XD – Figma –Invision -Sketch		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Rex Hartson, Pardha S Pyla,* ***"The UX Book: Agile UX Design for a Quality User Experience"****, Morgan Kaufmann, Second Edition, 2018*
2	*Joel Marsh,* ***"UX for beginners"****, O'Reilly Media, 2015*

REFERENCES :

1	*Alan Cooper, Robert Riemann, David Cronin, Christopher Noessel,* ***"About Face: The Essentials of Interaction Design"****, Wiley, Fourth Edition, 2014*
2	*Ben Coleman, and Dan Goodwin,* ***"Designing UX: Prototyping: Because Modern Design is Never Static"****, SitePoint , 2017*
3	*Westley Knight,* ***"UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work"****, Apress, 2018*
4	*https://in.coursera.org/specializations/user-interface-design*
5	*Helen Sharp, Yvonne Rogers, Jenny Preece,* ***"Interaction design – beyond human computer interaction"****, Wiley, Fifth Edition, 2019*
6	*Elizabeth Goodman, Mike Kuniavsky, Andrea Moed,* ***"Observing the User Experience – A Practitioner's Guide to User Research"****, Morgan Kaufmann, Second Edition, 2012*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Articulate UI/UXdesign principles, tools, and best practices, and apply them to real-world scenarios. **(Usage)**
CO2	Conduct user research to gain insights into user needs and behaviors, and apply these insights to inform design decisions. **(Usage)**
CO3	Create wireframes and prototypes using design software to communicate design ideas. **(Usage)**
CO4	Design interfaces that adapt to different devices and screen sizes using responsive design principles. **(Usage)**
CO5	Collaboratively design and evaluate interfaces for web and mobile applications using tools like Adobe XD, Figma , Invision and Sketch. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1			M	L	L							L	L	L	L	L
CO2			H	L	L					L		L	L	L	L	L
CO3		L	H	L	H					L		L	H	L	L	L
CO4			H	L	H							L	H	L	L	L
CO5		L	H	L	H					M		L	H	L	L	L
18SPE$28		L	H	L	H					L		L	H	L	L	L
L –Low, M- Medium, H- High																

18SPE$29	**APP DEVELOPMENT** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.Apply the basic concepts of DART programming language to solve simple problems 2.Understand the development process of mobile application framework and develop simple mobile application using Flutterthat provide a smooth, seamless user experience, using techniques such as user interface (UI) design, user testing, and iterative design 3. Collect and analyze data from mobile applications, using tools such as Google Analytics and Firebase, and use the insights to improve the app's performance, usability, and user engagement. 4. To understand the major mobile platforms, such as Android and iOS, and their respective development environments, including programming languages, tools, and APIs 5. To deploy mobile applications to the target platform, following best practices for distribution, monetization, and app store optimization.	
UNIT – I	**PROGRAMMING DART**	**(9 Periods)**
Creating a DART project - main function – variables – data types – conditionals – loops – functions – object-oriented programming – objects – classes – constructors - inheritance – abstract class - DART project structure and libraries		
UNIT – II	**INTRODUCTION TO FLUTTER**	**(9 Periods)**
Flutter framework – Installing Android Studio – Installing and Configuring Flutter SDK – Run flutter app on android virtual device and mobile phone – Flutter widgets – Scaffold – Image – Container – Row and column – Card – Icon - Layouts – State management – Form validation - Data structures and Collections – Lists – Maps - Exception handling		
UNIT – III	**FLUTTER NAVIGATION AND ROUTING**	**(9 Periods)**
Button Widget – Types – App Structure and navigation – Navigate with Named routes – Navigate to new screen and back - Send and return data among screens – Animate a widget – WebView widget – Introduction to Material design – Elements - Scrolling – Inputs and Selections – Dialogs – Alerts – Panels – MVC pattern - Provider – Consumer - Selector		
UNIT – IV	**FIREBASE, GPS AND GOOGLE MAPS**	**(9 Periods)**
JSON – Adding firebase to app - Firebase authentication – signup and login to Flutter app – Configuring Firebase authentication – Firebase database – Real time database – cloud Firestore – Location aware apps – Adding Google maps to Flutter app – Google map marker		
UNIT – V	**APP TESTING AND PUBLISHING**	**(9 Periods)**
Debugging tools – Dart analyzer – Flutter performance and optimizing - profiling – best practices – Deployment – code obfuscation – Build and release Android app – Build and release iOS app – Continuous delivery		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	*Sanjib Sinha, **"Beginning Flutter with Dart"**, Lean publishing, First Edition, 2021*
2	*Thomas Bailey, Alessandro Biessek, **"Flutter for Beginners"**, Packt Publishing, Second Edition, 2021*

REFERENCES :

1	*Sufyan bin Uzayr,* ***"Mastering Flutter – A Beginner's Guide"****, Taylor and Francis, First Edition, 2022*
2	*Simone Alessandria, Brian Kayfitz,* ***"Flutter Cookbook"****, Packt Publishing, First Edition, 2021*
3	*Rap Payne,* ***"Beginning App Development with Flutter: Create cross platform mobile apps"****, Apress, First Edition, 2019*
4	*Marco L Napoli,* ***"Beginning Flutter – A hands on guide to App Development"****, John Wiley & Sons, First Edition, 2020*
5	*https://docs.flutter.dev/*
6	*https://firebase.google.com/*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Setup a new Material App using Android Studio and use pre-made Flutter widgets for User Interface Design. **(Familiarity)**
CO2	Summarize the difference between Stateful and Stateless Widgets and Explore how Flutter widgets react to state changes. **(Usage)**
CO3	Apply common mobile design patterns to structure flutter apps and navigation. **(Usage)**
CO4	Design mobile applications with backend services, APIs and Create signup and login screens using Firebase Authentication and Cloud Firestore. **(Usage)**
CO5	Analyze the mobile app usage data and user feedback, and use the insights to improve app performance, usability, and user engagement. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**	**PS O4**
CO1	M	H	H	H	M				M	L	M	L	H		M	
CO2	M	H	H	H	M				M	L	M	L	H		M	
CO3	M	H	H	H	M				M	L	M	L	H		M	
CO4	M	H	H	H	M				M	L	M	L	H		M	
CO5	M	H	H	H	M				M	L	M	L	H		M	
18SPE$29	M	H	H	H	M				M	L	M	L	H		M	
L –Low, M- Medium, H- High																

VERTICALS-III

DATA SCIENCE AND ANALYTICS

18SPE$12	BIG DATA ANALYTICS

PRE-REQUISITES	CATEGORY	L	T	P	C
Database Management Systems	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with, Evolution of Big Data and its characteristics Domain specific analysis of Big data Mining larger data streams Concepts related to Link analysis and handle large and frequent data sets Frameworks for Big Data and its applications.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Introduction to Big Data – Platforms for Big Data – Traits - Challenges - Web Data – Analytic Scalability - Modern Data Analytic Tools - Big data sources – Acquisition – Big Data Security, Compliance, auditing and protection - Evolution of Big data – Best Practices for Big data Analytics - Data Appliance and Integration tools		
UNIT – II	**BIG DATA ANALYSIS**	**(9 Periods)**
Evolution of analytic scalability – Convergence – parallel processing systems - Cloud computing – grid computing – Map Reduce Framework - Hadoop – Hive – Sharding –Spark.– enterprise analytic sand box – analytic data sets - Analysis approaches – Statistical significance - Multivariate analysis, Bayesian modeling, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction.		
UNIT – III	**MINING DATA STREAMS**	**(9 Periods)**
The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing- distance measures – methods for high degree similarity.		
UNIT – IV	**LINK ANALYSIS**	**(9 Periods)**
Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam – Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream		
UNIT – V	**BIG DATA FRAMEWORKS AND APPLICATIONS**	**(9 Periods)**
NoSQL Databases - S3 - Hadoop Distributed file systems – Hbase – Impala –Big data for ECommerce – Big data for blogs – Case Study - Analyzing big data with twitter - Futuristic vision and applications of Big Data.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS :

1	Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2012.
2	Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.

REFERENCES :

1	Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012.
2	Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
3	Glenn J. Myatt, "Making Sense of Data", John Wiley & Sons, 2007.
4	Paul Zikopoulos, Dirk deRoos, Krishnan Parasuraman, Thomas Deutsch , James Giles, David Corrigan, "Harness the Power of Big data – The big data platform", McGraw Hill, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Explain platforms, traits and best practices of Big Data. [Familiarity]
CO2	Use statistical techniques to analyze Big Data and identify sample and mine larger data streams. [Usage]
CO3	Apply nearest neighbor search to calculate degree similarity between data. [Assessment]
CO4	Compare frameworks for Big Data and list their performance. [Usage]
CO5	Explain futuristic vision and applications of Big Data. [Familiarity]

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	H	H	H	H				H	H	H	H	M	H	H	H
CO2	H	H	H	H	H				H	H	H	H	M	H	H	H
CO3	M	H	L	L	H				L	L	L	H	M	H	H	H
CO4	M	H	M	M	H				H	M	L	H	L	H	H	H
CO5	H	H	H	M	H				H	H	M	H	M	H	H	H
18SPE$12	H	H	H	M	H				H	M	M	H	M	H	H	H
L - Low, M - Moderate, H – High																

18SPE$17	DATA WAREHOUSING AND DATA MINING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course the students will be familiar with: Building data warehouse using data model, warehouse architecture and OLAP server. Association mining techniques used for the development of efficient data mining system. Classification and prediction methods. Clustering the data using clustering techniques. Applications of data mining.	
UNIT – I	**INTRODUCTION TO DATA WAREHOUSE**	**(9 Periods)**
Introduction- a multi dimensional data model – Data cube technology-Data warehouse architecture- Types of OLAP servers-Data warehouse implementation-Data warehousing to data mining.		
UNIT – II	**INTRODUCTION TO DATA MINING**	**(9 Periods)**
Data mining – functionalities - Major issues - Data cleaning - Data integration and Transformation - Data reduction - Discretization and concept hierarchy generation-Efficient and scalable frequent item set mining methods-Mining various kinds of association rules-Association mining to correlation analysis-Constraint based association mining.		
UNIT – III	**CLASSIFICATION AND PREDICTION**	**(9 Periods)**
Introduction – Issues – Classification by decision tree induction - Bayesian classification- Rule based classification-Classification by back propagation- Other classification methods- Prediction-Accuracy and error measures- Evaluating the accuracy.		
UNIT – IV	**CLUSTER ANALYSIS**	**(9 Periods)**
Cluster analysis – Types of data – Partitioning methods – Hierarchical methods – Density based methods-Grid based methods – Model based Clustering methods – Clustering High dimensional data – Constraint based cluster analysis – outlier analysis.		
UNIT – V	**DATA MINING APPLICATIONS**	**(9 Periods)**
Data mining for financial analysis-Retail industry-Telecommunication industry-Biological data analysis-Other scientific applications-Intrusion detection.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS

1	*Jiewei Han, MichelineKamber, "**Data mining concepts and techniques**", Morgan Kaufmann Pub, Third Edition, 2011.*

REFERENCES

1	*William H. Inmon, "**Building the data ware house**", Wiley DreamtechPvt Ltd., Fourth Edition, 2005.*
2	*Ian H.Witten, Eibe Frank, "**Data Mining: Practical M/c Learning tools and techniques with Javaimplementation**", Morgan Kaufmann Pub, Third Edition, 2011.*
3	*K.P.Soman,ShyamDiwakar,V.Ajay, " **Insight into Data Mining, theory and practice**", PHI Pvt Ltd, 2006.*
4	*Ronen Feldman, James Sangee, "**The Text Mining Handbook: Advanced Approaches in analyzing unstructured data**", Cambridge University Press, 2007.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Develop financial data warehouse using Stars, snowflake, fact constellations schema and OLAP concepts. [Assessment]
CO2	Transform data to normalized form and solve problems using association mining. [Assessment]
CO3	Apply classification techniques like decision tree induction, Bayesian classification, Rule based classification and back propagation to classify an unlabeled data. [Usage]
CO4	Apply model based clustering method and remove the irrelevant data using outlier analysis. [Usage]
CO5	Analyze data mining for transaction analysis, biological data analysis, social network analysis. [Familiarity]

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	H	H	H	H				H	H	H	H	M	H	H	M
CO2	H	H	H	H	H				H	H	H	H	M	H	H	M
CO3	M	H	L	L	H				L	L	L	H	M	H	H	M
CO4	M	H	M	M	H				H	M	L	H	L	H	H	L
CO5	H	H	H	M	H				H	H	M	H	M	H	H	M
18SPE$17	H	H	M	H	H				H	M	M	H	M	H	H	M
L - Low, M - Moderate, H - High																

18SPE$08	COMPUTER VISION

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Upon completion of this course, the students will be familiar with: Fundamentals of image models. Filters, Features, Texture and Edge detection. Geometry of multiple views. Segmentation, Fitting and Tracking methods. Relationship between object features, image features and camera models.	
UNIT – I	**IMAGE FORMATION AND IMAGE MODELS**	**(9 Periods)**
Radiometry: Light in Space - Light at Surfaces - Radiosity - Directional Hemispheric -Reflectance - Lambertian Surfaces and Albedo - Specular Surfaces - Sources, Shadows and Shading: Radiometric Properties of Light Sources - Qualitative Radiometry - Local Shading Models - Global Shading Models. Colour: Human Colour Perception - Representing Colour - Geometric Image Features: Elements - Contour Geometry -Analytical Image Features: Elements - Geometric Camera Parameters - Calibration.		
UNIT – II	**EARLY VISION-ONE IMAGE**	**(9 Periods)**
Linear Filters: Linear Filters and Convolution - Shift invariant linear systems - Spatial Frequency and Fourier Transforms – Sampling- Edge Detection: Estimating Derivatives with Finite Differences - Noise - Edges and Gradient-based Edge Detectors. Filters and Features: Filters as Templates - Filters and Primate Early Vision - Normalised Correlation and Finding Patterns - Corners and Orientation Representations - Advanced Smoothing Strategies and Non-linear Filters. Texture: Representing Texture - Analysis Using Oriented Pyramids - Application: Synthesizing Textures for Rendering - Shape from Texture.		
UNIT – III	**EARLY VISION-MULTIPLE IMAGES**	**(9 Periods)**
The Geometry of Multiple Views -Two Views - Three Views - More Views. Stereopsis: Reconstruction - Binocular Fusion - Trinocular Stereo - Multiple-Baseline Stereo - Affine Structure from Motion: Elements - Affine Structure from Two Images and Multiple Images - Affine to Euclidean Images - Affine Motion Segmentation. Projective Structure From Motion: Elements - Projective Scene Reconstruction from Two Views - Motion Estimation from Two or Three Views - Motion Estimation from Multiple Views - From Projective to Euclidean Structure and Motion.		
UNIT – IV	**MID-LEVEL VISION**	**(9 Periods)**
Segmentation Using Clustering Methods - Human vision: Grouping and Gestalt -Applications: Shot Boundary Detection, Background Subtraction and Skin Finding - Image Segmentation by Clustering - Segmentation by Graph-Theoretic Clustering . Fitting :The Hough Transform -Fitting Lines - Fitting Curves - Fitting to the Outlines of Surfaces .Tracking: Tracking as an Abstract Inference -Linear Dynamic Models and the Kalman Filter - Non-Linear Dynamic Models -Particle Filtering - Data Association		
UNIT – V	**HIGH-LEVEL VISION**	**(9 Periods)**
Correspondence and Pose Consistency - Pose Consistency for Perspective Cameras - Affine and Projective Camera Models - Linear Combinations of Models - Obtaining Hypotheses by Pose Clustering - Obtaining Hypotheses Using Invariants - Finding Templates Using Classifiers - Building Classifiers From Class Histograms - Finding Skin Pixels Using A Classifier - Feature Selection - Recognition By Relations Between Templates - Finding Objects by Voting on Relations between Templates - Relational Reasoning using Probabilistic Models and Search - Using Classifiers to Prune Search		

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS :

1	*David Forsyth and Jean Ponce "**Computer vision: a modern approach**" 2nd edition, Pearson India Education Services Pvt. Ltd, 2012.*

REFERENCES :

1	Richard Szeliski, "Computer Vision- Algorithms and Applications", Springer Science & Business Media, 2011.
2	Simon J.D. Prince, "Computer Vision - Models, Learning and Inference", Cambridge University Press, 2012.
3	Linda G. Shapiro, George C. Stockman, "Computer Vision", Prentice Hall, 2001

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Apply fundamentals concepts of camera model and calibration to image formation and image model [Usage]
CO2	Apply Filters, Features, Texture and Edge detection techniques to enhance an image [Usage]
CO3	Recover 3D structure and Motion of objects using two views and multiple views of an object. [Usage]
CO4	Identify objects or other relevant information in digital images using segmentation, clustering and tracking methods. [Assessment]
CO5	Find the relationship between the position of image features, and the position and orientation of an object. [Usage]

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	H	M	M	L							M	H	M	M	M
CO2	H	H	M	M	L							M	H	M	M	M
CO3	H	H	M	M	L							M	H	M	M	M
CO4	H	H	L	M	L							M	H	M	M	M
CO5	H	H	L	M	L							M	H	M	M	M
18SPE$08	H	H	M	M	L							M	H	M	M	M
L - Low, M - Moderate, H - High																

18SPE$21	DEEP LEARNING

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	Emphasizing knowledge on various deep learning algorithms.	
UNIT – I	**INTRODUCTION TO DEEP LEARNING**	**(9 Periods)**
Basics: Biological Neuron, Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.		
UNIT – II	**FEEDFORWARD NETWORKS**	**(9 Periods)**
Representation Power of Feedforward Neural Networks, Backpropagation, Empirical Risk Minimization, Regularization, Autoencoders.		
UNIT – III	**DEEP NEURAL NETWORKS**	**(9 Periods)**
Difficulty of training deep neural networks, Greedy layerwise training. Gradient Descent (GD), Stochastic Gradient Descent (GD), Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), Regularization methods (dropout, drop connect, batch normalization).		
UNIT – IV	**CONVOLUTIONAL NEURAL NETWORKS**	**(9 Periods)**
Convolutional Networks: The Convolution Operation - Variants of the Basic Convolution Function - Structured Outputs - Data Types - Efficient Convolution Algorithms - Random or Unsupervised Features- LeNet, AlexNet		
UNIT – V	**RECURRENT NEURAL NETWORKS**	**(9 Periods)**
Recurrent Neural Networks: Bidirectional RNNs - Deep Recurrent Networks Recursive Neural Networks - The Long Short-Term Memory and Other Gated RNNs		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Ian Goodfellow and Yoshua Bengio and Aaron Courville., **" Deep Learning ",** MIT Press, 2016*

REFERENCES :

1	*Raúl Rojas, **" Neural Networks: A Systematic Introduction ",** Springer-Verlag, Berlin,1996.*
2	*Yegnanarayana, B., **" Artificial Neural Networks ",** PHI Learning Pvt. Ltd, 2009*
3	*Christopher Bishop., **" Pattern Recognition and Machine Learning ",** Springer,2016*
4	*Nikhil Buduma, **"Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms",** O'Reilly publications, 2017*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Summarize the basics of neural network and deep learning. **(Familiarity)**
CO2	Implement basic neural network model with hidden layers. **(Usage)**
CO3	Analyze optimization and generalization in deep learning. **(Assessment)**
CO4	Criticize convolutional neural network and how it is applied to analyzing visual imagery. **(Assessment)**
CO5	Appraise Recurrent Neural Network (RNN) and its temporal dynamic behavior which helps us to remembers some information about a sequence to predict the next information. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	L	M	L		L						L	H	L	L	M
CO2	H	H	H	M	H	L						L	H	M	M	M
CO3	H	H	H	H	H	L						L	H	L	M	L
CO4	H	H	H	H	H	L						L	H	L	M	M
CO5	H	H	H	H	H	L						L	H	L	M	M
18SPE$21	H	H	H	H	H	L						L	H	L	M	M
L –Low, M- Medium, H- High																

18SPE$30	**RECOMMENDER SYSTEMS** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	To summarize the various types of recommendation systems. To learn the content and knowledge based recommendations. To Understand the hybrid recommendations and explanations To familiarize various evaluating strategies to evaluate recommender systems. To learn advanced recommender systems and their applications.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Basic concepts and recent developments – Collaborative recommendation – User based and Item based nearest neighbor recommendation, Rating, Model based and Preprocessing based approaches, Recent practical approaches and systems.		
UNIT – II	**CONTENT AND KNOWLEDGE BASED RECOMMENDATION**	**(9 Periods)**
Content representation and content similarity – Similarity based retrieval, Text classification methods, Knowledge representation, Interacting with constraints based recommender systems - Interacting with Case based recommender systems – Example applications.		
UNIT – III	**HYBRID RECOMMENDATIONS AND EXPLANATIONS**	**(9 Periods)**
Opportunities for hybridization – Monolithic hybridization design – Parallelized hybridization design – Pipelined hybridization design – Explanations in recommender systems – Explanations in collaborative filtering recommenders.		
UNIT – IV	**EVALUATING RECOMMENDER SYSTEMS**	**(9 Periods)**
Properties of evaluations – Popular evaluation designs – Evaluations on historical datasets – Alternative evaluation designs - Case study: Personalized game recommendations on the mobile Internet		
UNIT – V	**RECOMMENDER SYSTEMS AND THE NEXT-GENERATION WEB**	**(9 Periods)**
Trust-aware recommender systems- Folksonomies- Ontological filtering- Extracting semantics from the web- Recommendations in ubiquitous environments- Context-aware recommendation- Application domains.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total:45 Periods**		

TEXT BOOK

1	*Dietmar Jannach, Markus Zanker, Alexander Felfernig, and Gerhard Friedrich, "**Recommender Systems An Introduction**", Cambrige University Press, 2011*
2	*Charu C. Aggarwal, " **Recommender Systems",** Springer, 2016.*

REFERENCES

1	*Manouselis N, Drachsler H, Verbert K, Duval E, "**Recommender Systems For Learning** ", Springer, 2013*
2	*Ricci F, Rokach L, Shapira D, Kantor B.P, "**Recommender Systems Handbook**" Springer, 2015*
3	*Kim Falk, "**Practical Recommender Systems**", Manning Publications, 2019.*
4	*Michael Schrage, "**Recommendation Engines**", MIT Press, 2020.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Summarize various types of recommendation techniques. **(Familiarity)**
CO2	Compare content based recommendations and Knowledge based recommendations. **(Familiarity)**
CO3	Identify appropriate hybrid recommendation models for specific underlying applications. **(Usage)**
CO4	Assess the recommendations based on well-defined metrics. **(Analyze)**
CO5	Describe emerging applications based on Web 2.0 and Semantic Web technologies. **(Familiarity)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	L	H													M	M
CO2	L	H	L												H	H
CO3	L	M	L	H									M		H	H
CO4	L	H	L	H									M		H	H
CO5	L	M	L	H									M		H	H
18SPE$30	L	H	L	M									M		H	H
L –Low, M- Medium, H- High																

18SPE$31	EXPLORATORY DATA ANALYSIS *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.To understand the representations and distribution of data using descriptive statistics. 2.To learn the basics of inferential statistics and sampling distribution. 3.To learn the estimation of parameters using basic and hypotheses test. 4.To perform t-test for one sample and two independent samples. 5.To use different techniques for analysis of variance.	
UNIT – I	**DESCRIPTIVE STATISTICS**	**(9 Periods)**
Frequency distribution for quantitative and qualitative data – Graph for quantitative and qualitative data – normal distributions and standard (z) scores – correlation – regression.		
UNIT – II	**INFERENTIAL STATISTICS**	**(9 Periods)**
Populations – samples – random sampling – probability and statistics Sampling distribution – creating a sampling distribution – mean of all sample means – standard error of the mean –Hypothesis testing – z-test – z-test procedure – statement of the problem – null hypothesis – alternate hypotheses – decision rule – calculations – decisions – interpretations.		
UNIT – III	**INFERENTIAL STATISTICS CONTINUED**	**(9 Periods)**
Need for hypothesis tests – Strong or weak decisions – one-tailed and two-tailed tests – case studies - Influence of sample size – power and sample size Estimation – point estimate – confidence interval – level of confidence – effect of sample size.		
UNIT – IV	**T-TEST**	**(9 Periods)**
t-test for one sample – sampling distribution of t – t-test procedure – degrees of freedom – estimating the standard error –t-test for two independent samples – statistical hypotheses – sampling distribution – test procedure – p-value – statistical significance – estimating effect size – meta analysis -t-test for two related samples.		
UNIT – V	**ANALYSIS OF VARIANCE**	**(9 Periods)**
F-test – ANOVA – estimating effect size – multiple comparisons – case studies Analysis of variance with repeated measures - Two-factor experiments – three f-tests – two-factor ANOVA – other types of ANOVA - Introduction to chi-square tests.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Robert S. Witte and John S. Witte,* ***"Statistics",*** *11th Edition, Wiley Publications, 2017.*

REFERENCES

1	*Allen B. Downey,* ***"Think Stats: Exploratory Data Analysis in Python",*** *Green Tea Press, 2014*
2	*Peter Bruce, Andrew Bruce, and Peter Gedek,* ***"Practical Statistics for Data Scientists",*** *2nd Edition, O'Reilly Publishers, 2020*
3	*Bradley Efron and Trevor Hastie,* ***"Computer Age Statistical Inference",*** *Cambridge University Press, 2016*
4	*Charles R. Severance,* ***"Python for Everybody: Exploring Data in Python 3",*** *Shroff Publishers, 2017*
5	*David Spiegelhalter,* ***"The Art of Statistics: Learning from Data",*** *Pelican Books, 2019.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the description and distribution of data. **(Understand)**
CO2	Understand the concept of sampling and derive hypothesis for data. **(Understand)**
CO3	Perform basic tests and hypotheses test for estimation of parameters. **(Usage)**
CO4	Apply t-test for one sample and two independent samples. **(Usage)**
CO5	Analyze the variance by applying different types of tests. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	H	H	H	L					L		L	H	M		L
CO2	H	H	H	H	L					L		L	H	M	L	H
CO3	H	H	H	H	L					L		L	H	M	M	H
CO4	H	M	M	M	L					L		L	H	M	L	M
CO5	H	M	M	M	L					L		L	H	M		L
18SPE$31	H	M	M	M	L							L	H	M	L	M
L –Low, M- Medium, H- High																

18SPE$32	VIDEO ANALYTICS

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To learn about video processing techniques and understand the video standards. 2. To understand about motion estimation algorithms. 3. To appreciate various techniques used for segmentation and tracking for analysis video data 4. To apply filtering and compression techniques for video analysis 5. To learn about current trends and applications in video analysis	
UNIT – I	**VIDEO FUNDAMENTALS**	**(9 Periods)**
Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Sampling for analog and digital video – Rectangular and periodic 2-D sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features		
UNIT – II	**TWO DIMENSIONAL MOTION ESTIMATION**	**(9 Periods)**
Fundamentals of Motion Estimation – Optical Flow Methods: 2D Motion Estimation, OF equation methods – Block Based Methods: Block Motion, Phase correlation and Block matching method –Pel Recursive Methods – Bayesien Methods: Optimizations, MAP motion estimation algorithms –Frequency Domain Motion Estimation.		
UNIT – III	**3D MOTION ESTIMATION AND SEGMENTATION**	**(9 Periods)**
Point Correspondences Methods: Orthographic model, Perspective model, 3D planer surfaces – Optical Flow and Direct methods – Motion segmentation: Dominant-Motion Segmentation - Multiple-Motion Segmentation - Region-Based Motion Segmentation: Fusion of Color and Motion - Simultaneous Motion Estimation and Segmentation – Motion Tracking : Kalman, Particle Filter based tracking - Multi-target/Multi-camera tracking		
UNIT – IV	**VIDEO FILTERING AND COMPRESSION**	**(9 Periods)**
Video Filtering – Motion Compensated Filtering – Noise filtering – Intra frame and motion adaptive filtering – Restoration – Intraframe and multiframe restoration – Super resolution – Video compression: Approaches, basic compression standards: MPEG-1, MPEG-2 – H.264 –HEVC – stereo and multi view video compression		
UNIT – V	**VIDEO ANALYSIS AND APPLICATIONS**	**(9 Periods)**
Video Quality Assessment - Video Indexing, Summarization and Retrieval – Video Security and Protection – Wireless video Streaming – Video Surveillance – Face Recognition from video - Audiovisual speech processing - Automatic Video Trailer Generation– Video in painting– Forensic Video Analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*A. Murat Tekalp, "**Digital Video Processing**", Second Edition, Prentice Hall, 2015.*

REFERENCES :

1	*Oges Marques, **"Practical Image and Video Processing Using MATLAB",** Wiley and Sons (IEEE Press), 2011*
2	*Alan C. Bovik, **"Handbook of Image and Video processing",** Second Edition, Academic Press, 2005*
3	*Al Bovik (Alan C Bovik, **"The Essential Guide to Video Processing",** Academic Press, Second Edition, 2009*
4	*Yunqian Ma, Gang Qian, **"Intelligent Video Surveillance: Systems and Technology",** CRC Press (Taylor and Francis Group), 2009.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Analyze and implement the basic video processing algorithms in modern technologies **(Usage)**
CO2	Analyze the approaches for identifying and tracking objects and person with motion based algorithms **(Assessment)**
CO3	Segment video based on its features. **(Usage)**
CO4	Analyze the various filtering and video compression standards **(Assessment)**
CO5	Analyze the usage of video in various applications **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	H	H	M	M	L							L	M	M	L	L
CO2	M	H	M	M	M							L	M	M	L	M
CO3	H	H	M	M	M							L	M	M	L	M
CO4	H	H	M	M	M							L	M	M	L	M
CO5	H	H	H	H	M							M	M	M	M	M
18SPE$32	H	H	M	M	M							L	M	M	L	M
L –Low, M- Medium, H- High																

VERTICAL – IV

CYBER SECURITY

18SPE$33	**MODERN CRYPTOGRAPHY** *(Common to CSE &IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on number theory and basic cryptography	**PE**	**3**	**0**	**0**	**3**

Course Objectives	1.Principles and concepts of modern cryptography. 2.Modern public key cryptographic algorithms. 3.Number Theory and private key cryptography. 4.Identity based encryption mechanism. 5.Post quantum cryptographic algorithms.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Cryptography and Modern Cryptography- Basic Principles of Modern Cryptography - Perfectly-Secret Encryption - Computational Complexity - Zero-knowledge Properties - Zero-knowledge Argument - Protocols with Two-sided-error - Round Efficiency - Non-interactive Zero-knowledge.		
UNIT – II	**SYMMETRIC CRYPTOGRAPHY**	**(9 Periods)**
Computational Approach to Cryptography - Defining Computationally-Secure Encryption – Secure Communication and Message Integrity-Collision-Resistant Hash Functions - NMAC and HMAC -One-Way Functions -Limitations of Private-Key Cryptography.		
UNIT – III	**ASYMMETRIC CRYPTOGRAPHY**	**(9 Periods)**
Primes and Divisibility - Modular Arithmetic - Cyclic Groups - Algorithms for Factoring -, Computing Discrete Logarithms - Goldwasser-Micali Encryption Scheme - Rabin Encryption Scheme - Paillier Encryption Scheme - Digital Signature Schemes - Lamport's One-Time Signature Scheme - Signatures from Collision-Resistant Hashing		
UNIT – IV	**IDENTITY BASED ENCRYPTION**	**(9 Periods)**
Bilinear map – Security Model- Hardness Assumptions - Boneh-Franklin Identity based Encryption(IBE) – Gentry's IBE- Dual System Encryption – Waters' IBE - Boneh-Boyen IBE – Security Model for Hierarchical IBE - Waters' Realization – Generic Group Model.		
UNIT – V	**POST QUANTUM CRYPTOGRAPHY**	**(9 Periods)**
Lattice Problems – NTRU Cryptosystem - Lattice-Based Cryptography – Ring Variants of Learning with Errors (LWE)& Learning with Rounding (LWR) - (LWE+LWR)-Based Public-Key Encryption – Ring Variant of Lizard- Code based Cryptography: McEliece&Niederreiter Cryptosystem, Security Analysis.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Jonathan Katz and Yehuda Lindell,* ***"Introduction toModern Cryptography",*** *CRC press, 2008.*
2	*Intae Kim, Wai Kong Lee, SeongOun Hwang,* ***"Modern Cryptography with Proof Techniques and Implementations",*** *CRC press, 2021.*

REFERENCES :

1	*William Stallings,* ***"Cryptography and Network security Principles and Practices",*** *Pearson/PHI, 2016.*
2	*Wade Trappe, Lawrence C Washington,* ***"Introduction to Cryptography with coding theory",*** *Pearson, 2020.*
3	*W. Mao,* ***"Modern Cryptography – Theory and Practice",*** *Pearson Education, 2003.*
4	*Song Y. Yan , "Computational Number Theory and Modern Cryptography", Wiley, 2013.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Realize the modern cryptographic principles and concepts. **(Familiarity)**
CO2	Apply symmetric cryptography mechanism for encryption using hash functions**. (Usage)**
CO3	Apply asymmetric cryptography mechanism for public key encryption**. (Usage)**
CO4	Demonstrate identity based encryption using hardness assumption and security models. **(Usage)**
CO5	Use post-quantum standardization algorithms. **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	M										L	M			L
CO2	M	M	M	L		L						L	M			L
CO3	M	M	M	L		L						L	M		L	L
CO4	M	M	M	H		L					L	L	M		L	L
CO5	M	M	L	H	M	L					M	L	M		L	L
18SPE$33	M	M	M	M	L	L					L	L	M		L	L
L –Low, M- Medium, H- High																

18SPE$34	NETWORK SECURITY

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1. To learn about basic concepts of network security and cryptographic algorithms 2. To understand the need of transport layer security, email security and wireless network security. 3. To learn about various intrusion detection systems and firewalls used for network security	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Computer Security Concepts - OSI Security Architecture - Security Attacks, Services , Mechanisms - Model for Network Security - Classical Encryption Techniques - Block Cipher Principles - Data Encryption Standard (DES)- Advanced Encryption Standard (AES) - Stream Ciphers - RC4.		
UNIT – II	**PUBLIC-KEY CRYPTOGRAPHY & DATA INTEGRITY ALGORITHMS**	**(9 Periods)**
Principles of Public-key cryptosystems – RSA algorithm - Diffie-Hellman Key Exchange - The ElGamal Cryptosystem – Secure hash algorithm – Message authentication codes – Digital signatures - X.509 Certificates - Kerberos		
UNIT – III	**TRANSPORT-LEVEL SECURITY & E-MAIL SECURITY**	**(9 Periods)**
Transport-Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS standard, Secure Shell (SSH) application. Electronic Mail Security: Pretty Good Privacy, S/MIME, DomainKeys Identified Mail.		
UNIT – IV	**INTRUSION AND FIREWALLS**	**(9 Periods)**
Intrusion: Intruders – Hackers – Password Management - Intrusion detection – Honeypots – Malicious software – Distributed denial of service Firewall: Need for firewall – Firewall Characteristics – Types of Firewall – Firewall Configuration – Virtual private network		
UNIT – V	**WIRELESS NETWORK SECURITY**	**(9 Periods)**
IEEE 802 Protocol Architecture IEEE 802.11 Network Components and Architectural Model IEEE 802.11 Services - IEEE 802.11i Wireless LAN Security - Wireless Application Protocol- Wireless Transport Layer Security - WAP End-to-End Security		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*William Stallings,* ***"Cryptography and Network security Principles and Practices",*** *5th edition, Pearson Education, 2010*

REFERENCES :

1	*William Stallings,* ***"Network security essentials - application and standards",*** *6th edition, Prentice Pearson Education, 2017*
2	*J. Michael Stewart; Denise Kinsey,* ***"Network Security, Firewalls, and VPNs",*** *3rd Edition, Jones & Bartlett Learning, 2020*
3	*Michael Gregg,* ***"The Network Security Test Lab - A Step-by-Step Guide",*** *John Wiley & Sons Inc, 2015*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Explain the basic concepts of network security and classical encryption techniques. **(Familiarity)**
CO2	Apply public key cryptography for encryption and authentication. **(Usage)**
CO3	Explain the security needs in transport layer and for e-mail. **(Familiarity)**
CO4	Analyze the type of firewall to overcome intrusion in the system. **(Assessment)**
CO5	Explain the standards used in wireless network security. **(Familiarity)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	H	L	L		L				L		L	H		M	L
CO2	M	H	H	L		L				L		L	H		M	L
CO3	M	H	L	L		L				L		L	H		M	L
CO4	M	H	H	L		L				L		L	H		M	L
CO5	M	H	L	L		L				L		L	H		M	L
18SPE$34	M	H	M	L		L				L		L	H		M	L
L –Low, M- Medium, H- High																

18SPE$35	SECURITY AND PRIVACY IN CLOUD *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
NIL	PE	3	0	0	3

Course Objectives	1.To understand the evolution of Cloud Computing and IT infrastructure security capabilities at the network, host, and application levels 2.To familiarize with data security and storage of data in the cloud, identity and access management (IAM) 3.To learn about security management frameworks and the standards 4.To understand the fundamentals of privacy aspects to consider within the context of cloud computing 5.To know about the importance of audit and compliance functions within the cloud	
UNIT – I	**INTRODUCTION AND SECURITY LEVELS**	**(9 Periods)**
The Evolution of Cloud Computing, Key Drivers to Adopting the Cloud,The Impact of Cloud Computing on Users, Governance in the Cloud Barriers to Cloud Computing Adoption in the Enterprise. Infrastructure Security - The Network Level, The Host Level, The Application Level.		
UNIT – II	**DATA SECURITY AND STORAGE**	**(9 Periods)**
Aspects of Data Security, Data Security Mitigation, Provider Data and Its Security Identity and Access Management- Trust Boundaries and IAM, IAM Challenges, IAM Definitions, IAM Architecture and Practice, IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management, Cloud Service Provider IAM Practice		
UNIT – III	**SECURITY MANAGEMENT IN THE CLOUD**	**(9 Periods)**
Security Management Standards, Security Management in the Cloud - Availability Management, SaaS Availability Management, PaaS Availability Management, IaaS Availability Management, Access Control - Security Vulnerability, Patch, and Configuration Management.		
UNIT – IV	**PRIVACY**	**(9 Periods)**
Privacy, Data Life Cycle, Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications		
UNIT – V	**AUDIT AND COMPLIANCE**	**(9 Periods)**
Internal Policy Compliance - Governance, Risk, and Compliance (GRC), Illustrative Control Objectives for Cloud Computing, Incremental CSP-Specific Control Objectives, Additional Key Management Control Objectives, Control Considerations for CSP Users, Regulatory/External Compliance, Other Requirements, Cloud Security Alliance, Auditing the Cloud for Compliance.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Tim Mather, Subra Kumaraswamy, and Shahed LatifCopyright**, "Cloud Security and Privacy",** O'Reilly Media, 2009.*

REFERENCES :

1	John R. Vacca, **"*Cloud Computing Security Foundations and Challenges",*** CRC Press,2nd Edition,2020.
2	*Siani Pearson, George Yee* ***"Privacy and Security for Cloud Computing"*** *Computer Communications and Networks, Springer, 2013.*
3	*Ronald L. Krutz, Russell Dean Vines,* ***"Cloud Security: A Comprehensive Guide to Secure Cloud Computing",*** *Wiley Publishing, 2010*
4	*Ben Halper,* ***"Auditing Cloud Computing: A Security and Privacy Guide"*** *John Wiley & Sons, Inc. Publications, 2011.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Describe the evolution of cloud computing and IT infrastructure security capabilities that cloud services generally offer. **(Familiarity)**
CO2	Examine the current state of data security and the storage of data in the cloud and Explain the identity and access management (IAM) practice and support capabilities for authentication, authorization, and auditing of users who access cloud services. **(Usage)**
CO3	Depicts security management frameworks and the standards that are relevant for the cloud. **(Familiarity)**
CO4	Explain the privacy aspects to be consider within the context of cloud computing and analyzes the similarities and differences with traditional computing models **(Familiarity)**
CO5	Enumerate the importance of audit and compliance functions within the cloud along with the various standards and frameworks. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	L	M	M	L	M	L					M	L	L	M	M	M
CO2	L	M	M	L	M	L					M	L	L	M	M	M
CO3	L	M	M	L	M	L					M	L	L	M	M	M
CO4	L	M	M	L	M	L					M	L	L	M	M	M
CO5	L	M	M	L	M	L					M	L	L	M	M	M
18SPE$35	L	M	M	L	M	L					M	L	L	M	M	M
L –Low, M- Medium, H- High																

18SPE$36	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Cryptography and Computer Networks	**PE**	**3**	**0**	**0**	**3**

Course Objectives	Upon completion of this course, the students will be familiar with, Blockchain concepts and its types. Blockchain networks and Block synchronization. Basics of bitcoins in cryptocurrency. Smart contracts and Ethereum networks. Applications of Blockchain in financial and non financial projects.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Blockchain definitions- Database vs. blockchain- History, motivations & Characteristics - Background of Distributed Ledger Technology - Different types of blockchain- Building blocks- Moore's Law &Blockchain - Cryptography in blockchain- Cryptographic hashing- Digital signatures in blockchain.		
UNIT – II	**NETWORKS IN BLOCKCHAIN**	**(9 Periods)**
P2P networking architecture- Network discovery - Block synchronization - Building a simple blockchain in a P2P network - Blockchain structure - Blockchain networks - Bitcoin hard forks and altcoins - cryptocurrency application.		
UNIT – III	**BITCOIN & CRYPTOCURRENCY**	**(9 Periods)**
Tokens in Cryptocurrency - Non-Fungible Tokens: Types, Extrinsic Elements, Creating and Minting, Buying and Selling - Fungible Tokens: Bitcoin basics, Keys and addresses, Transactions - Mining and consensus – Bitcoin Network and Payments- Bitcoin Clients and APIs - Alternative Coins- MultiChain platform - Setting up a blockchain environment.		
UNIT – IV	**SMART CONTRACTS & ETHEREUM**	**(9 Periods)**
Proof of Existence architecture - Building the Proof of Existence application - Digital assets and identity - Proof of ownership- Smart contracts- NEO blockchain - Choosing the smart contract platform –Ethereum network - Components of the Ethereum ecosystem- Test networks –Setting and Starting up a private network.		
UNIT – V	**BLOCKCHAIN APPLICATIONS**	**(9 Periods)**
Financial blockchain projects- Non-financial blockchain projects- Blockchain optimizations - Blockchain enhancements - Transaction security model- Decentralized security model - Attacks on the blockchain– Block in Financial system and crowdfunding.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Bashir Imran,* ***"Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained"*** *Packt publisher,2017.*
2	*Koshik Raj,* ***"Foundations of Blockchain:The pathway to cryptocurrencies and decentralized blockchain applications",*** *Packt publisher, 2019.*

REFERENCES :

1	Fortnow Matt, Terry QuHarrison, "The NFT Handbook: How to Create, Sell and Buy Non-Fungible Tokens", Wiley, 2021.
2	Chris Dannen, "Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners", Apress publisher, 2017.
3	S. Shukla, M. Dhawan, S. Sharma and S. Venkatesan, "Blockchain Technology: Cryptocurrency and Applications", Oxford University Press, 2019.
4	*Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.*

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Understand the basics and apply cryptographic concepts in blockchain. **(Familiarity)**
CO2	Apply the concepts P2P to achieve decentralization in the blockchain network. **(Usage)**
CO3	Demonstrate the concepts of Tokens and decentralized application development using MultiChain blockchain framework. (Usage)
CO4	Apply proof of existence and ownership through smart contracts. **(Usage)**
CO5	Examine blockchain concepts for various financial and Non-financial applications. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M	M		L									M	L	L	
CO2	M	M	L	L										L	M	L
CO3	M	M	M	M	M								M	L	H	
CO4	M	M	M	M			L	M				L	M			M
CO5	M	M	M	M	M	L	L					L			L	M
18SPE$36	M	M	M	M	L	L	L	L				L	M	L	L	M
L –Low, M- Medium, H- High																

18SPE$37	**ETHICAL HACKING** *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Computer networks and Web technology	**PE**	**3**	**0**	**0**	**3**

Course Objectives	1. To explore the concepts of security testing and the knowledge required to protect against the hacker and attackers. 2. To understand reconnaissance and the publicly available tools used to gather information on potential targets. 3. To discover the scanning techniques used to identify network systems open ports. 4. To identify network system vulnerabilities and confirm their exploitability. 5. To explore techniques for identifying web application vulnerabilities and attacks.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Introduction to Hacking –Important Terminologies – Hacktivism – Computer Crimes and Implications. Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement–Penetration Testing Methodologies: OSSTMM–NIST –OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports		
UNIT – II	**INFORMATION GATHERING AND SCANNING**	**(9 Periods)**
Information Gathering Techniques: Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Traceroute: ICMP, TCP and UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.		
UNIT – III	**NETWORK ATTACKS**	**(9 Periods)**
Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks –MAC flooding - Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic –DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation –Attacking Network Remote Services – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.		
UNIT – IV	**EXPLOITATION**	**(9 Periods)**
Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Cracking the Hashes: Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.		
UNIT – V	**WIRELESS AND WEB HACKING**	**(9 Periods)**
Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network UsingAircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking theAuthentication – Brute Force and Dictionary Attacks – Log-In Protection Mechanisms – Captcha Validation Flaw –Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability– Session Attacks – SQL Injection Attacks.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*RafayBaloch, **"Ethical Hacking and Penetration Testing Guide"**, CRC Press, 2014.*

REFERENCES :

1	*Kevin Beaver, **"Ethical Hacking for Dummies"**, Sixth Edition, Wiley, 2018.*
2	*Kimberly Graves, **Certified Ethical Hacker STUDY GUIDE**, Wiley publication, 2010.*
3	*Michael Gregg, **Certified Ethical Hacker**, Pearson publication, 2014.*
4	*Matt Walker, **All-in-one Certified Ethical Hacker Exam Guide**, McGraw Hill Edition, 2012.*
5	*Jon Erickson, **"Hacking: The Art of Exploitation"**, Second Edition, Rogunix, 2007.*

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Use the various security tools to assess and to predict the vulnerabilities across any computing system using penetration testing. **(Familiarity)**
CO2	Identify prediction mechanism to prevent any kind of attacks using information gathering mechanisms. **(Usage)**
CO3	Protect the system using scanning techniques from malicious software and worms. **(Usage)**
CO4	Evaluate the wireless network flaws and able to apply security patches with different exploitations. **(Assessment)**
CO5	Analyze the risk and support the organization for effective security measures. **(Familiarity)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1	M		M	L	M			L		M			L		L	
CO2	M	H	L	L	M			L					M		M	
CO3	H		H	L	M	M		H		M			H	M	H	
CO4	H	H	H	M	H	M		M					M		M	
CO5	H	H	L	L	L			L					L		M	M
18SPE$37	H	H	H	L	M	L		L		M			M	M	M	M
L – Low, M – Moderate, H – High																

18SPE$38	DIGITAL AND MOBILE FORENSICS *(Common to CSE & IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Digital Data, concepts of Operating systems and functionalities of Network layers.	**PE**	**3**	**0**	**0**	**3**

Course Objectives	1. Aspects and principles of digital data as evidence. 2. Cybercrime laws and duties of experts. 3. Techniques to conduct/report a digital forensics investigation. 4. Recovery of digital evidence using a variety of software utilities. 5. Role of internet in cyber crime investigation.	
UNIT – I	**DIGITAL EVIDENCE**	**(9 Periods)**
Digital Evidence- Increasing Awareness of Digital Evidence- Principles of Digital Forensics- Challenging Aspects of Digital Evidence- Following the Cybertrail- Language of Computer Crime Investigation - Role of Computers in Crime.		
UNIT – II	**CYBER CRIME AND LAWS**	**(9 Periods)**
Duty of Experts- Admissibility - Levels of Certainty in Digital Forensics- Direct versus Circumstantial Evidence- Scientific Evidence- Presenting Digital Evidence- Federal Cybercrime Law- Constitutional Law- Specific Cybercrime Offenses- Computer-Integrity Crimes- Computer-Assisted Crimes- Content-Related Cybercrimes.		
UNIT – III	**DIGITAL INVESTIGATIONS**	**(9 Periods)**
Digital Investigation Process Models- Scaffolding- Applying the Scientific Method- Guidelines for Handling Digital Crime Scenes- Fundamental Principles- Authorization- Digital Crime Scene: Preparing to Handle, Surveying, Preserving- Equivocal Forensic Analysis- Crime Scene Characteristics - Threshold Assessments- Modus Operandi- Motive and Technology.		
UNIT – IV	**COMPUTER AND MOBILE FORENSICS**	**(9 Periods)**
Representation of Data- Storage Media and Data Hiding- File Systems and Location of Data- Dealing with Password Protection and Encryption- Applying Forensic Science to Computers- Digital Evidence: Windows Systems, UNIX Systems, Macintosh Systems- Understanding Mobile Device Security - Analyzing SIM Cards - Analyzing Android, BlackBerry and iOS devices.		
UNIT – V	**NETWORK FORENSICS**	**(9 Periods)**
Role of the Internet in Criminal Investigations- Connecting Networks Using Internet Protocols- Legitimate versus Criminal Uses- Using the Internet as an Investigative Tool- Online Anonymity and Self-Protection- Forgery and Tracking: E-mail, Usenet- Linking the Data-Link and Network Layers: Encapsulation- Documentation, Collection, and Preservation- Analysis Tools and Techniques- TCP/IP-Related Digital Evidence.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Eoghan Casey, ***"Digital Evidence and Computer Crime: Forensic Science, Computers and the Internet"***, Elsevier, Third Edition, 2011.
2	Reiber Lee, **"Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation"**, McGraw Hill LLC, Second Edition, 2018.

REFERENCES :

1	Soufiane Tahiri, **"*Mastering Mobile* *Forensics*"**, Packt Publishing, 2016.
2	Oleg Afonin, **"*Mobile Forensics – Advanced Investigative* *Strategies*"**, Packt Publishing, 2016.
3	Filipo Sharevski, **"*Mobile Network Forensics Emerging Research and Opportunities*"**, IGI Global, 2018.
4	Ali Dehghantanha, Kim-Kwang Raymond Choo, **"*Investigations of Cloud and Mobile Applications*",** Elsevier Science, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to:	
CO1	Define the terminologies involved in digital evidence and different aspects of computer crime investigations. **(Familiarity)**
CO2	Recite legal issues that arise in computer-related investigations and cyber laws. **(Familiarity)**
CO3	Demonstrate the usage of digital evidence in reconstructing a crime or incident, identify suspects and understand criminal motivations. **(Usage)**
CO4	Recognize the role of computers and digital devices in crime investigations. **(Assessment)**
CO5	Examine and understand the underlying complexity of computer networks in digital investigation mechanism. **(Assessment)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PS O3**	**PSO 4**
CO1	M	L		L		L										
CO2	M	L	L	L		L						L				
CO3	M	L	M	M	L	L	L	L				L		M	M	
CO4	M	M	M	M	L	L	L	L				L		M	M	
CO5	M	L	M	M	L	L	L	L				L		M	M	
18SPE$38	M	L	M	M	L	L	L	L				L		M	M	
L –Low, M- Medium, H- High																

18SPE$39	SOCIAL NETWORK SECURITY *(Common to CSE &IT)*

PRE-REQUISITES	CATEGORY	L	T	P	C
Knowledge on Cryptography, Information Security and Network Security	PE	3	0	0	3

Course Objectives	1. The need for security and privacy in online social networks. 2. Understand issues and challenges associated with securing social networks. 3. Crowdsourcing and its effects 4. Trust management and context aware resource discovery in online social networks. 5. Understand the behavioral characteristics of end users.	
UNIT – I	**INTRODUCTION**	**(9 Periods)**
Structure and Evolution of Online Social Networks – Diffusion of Information - Security and Privacy in Social Networks – Privacy and anonymization in Social Networks - Interdisciplinary Impact Analysis of Privacy in Social Networks.		
UNIT – II	**SECURITY ISSUES AND TECHNICAL CHALLENGES**	**(9 Periods)**
Risks of Social Networking – False information and information leakage – Retention – Backup – Loss of data – Risk Management – Policies and privacy – Handling fake account, passwords, privacy and information sharing – content security.		
UNIT – III	**CROWDSOURCING AND ITS MEASURES**	**(9 Periods)**
Recognizing Your Digital Friends - Encryption and Decryption for Peer-to-Peer Social Networks - Crowdsourcing and Ethics - The Effect of Social Status on Decision-Making - Applications of k-Anonymity and ℓ-Diversity in Publishing Online Social Networks		
UNIT – IV	**CONTROLLED INFORMATION SHARING**	**(9 Periods)**
Managing security issues in social networks – Trust Management – Types of trust – Controlled Information Sharing – Secure resource discovery – Context Awareness - Access Control and Inference for Social Networks.		
UNIT – V	**PROFILING ONLINE USERS**	**(9 Periods)**
Profiling Online Users: Emerging Approaches and Challenges - Securing Mobile Social Networks- Protecting Regular and Social Network Users in a Wireless Network by Detecting Rogue Access Point: Limitations and Countermeasures- Cross-Site Scripting Attack – Defense against Online Social Networks		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	Yaniv Altshuler, Yuval Elovici, Armin B.Cremers, Nadav Aharony, Alex Pentland, **" *Security and Privacy in Social* *Networks*"**, Springer , 2012
2	Michael Cross, **"*Social Media Security: Leveraging Social Networking While Mitigating Risk*"**, Syngress, 2013.

REFERENCES :

1	Barbara Carminati , Elena Ferrari , Marco Viviani, **"*Security* and Trust in Online Social Networks",** Springer, 2014.
2	Al-Sakib Khan Pathan, **" *Securing Social Networks in Cyberspace"***, CRC Press, 2022
3	Bhavani Thuraisingham, Satyen Abrol, Raymond Heatherly, Murat Kantarcioglu, Vaibhav Khadilkar, Latifur Khan, **"*Analyzing and Securing Social Networks*",** Auerbach Publications, 2020.
4	**Brij B. Gupta, Somya Ranjan Sahoo, "*Online Social Networks Security Principles, Algorithm, Applications, and Perspectives*", CRC Press, 2021.**

COURSE OUTCOMES:	
On completion of the course, the students will be able to:	
CO1	Recite the need for security and privacy in Social Networks. **(Familiarity)**
CO2	Argue Risk Management, Policies and Decision making in Social Networks. **(Familiarity)**
CO3	Describe Crowdsourcing and its countermeasures for Online Social Networks. **(Familiarity)**
CO4	Examine trust, privacy and access control mechanisms for Social Networks. **(Usage)**
CO5	Determine and analyze attacks on Social Networks. **(Usage)**

COURSE ARTICULATION MATRIX:

COs/POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CO1		L													M	M
CO2		M	L										L		M	H
CO3	L	M	L	H	H	M		M					L		M	H
CO4	L	M	L	M	H			M					M		M	H
CO5	L	M	L	H	H	M		M					M		M	H
18SPE$39	L	M	L	M	H	M		M					M		M	H
L –Low, M- Medium, H- High																